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# Mindful Eco-Wellness: Steps Toward Personal and Planetary Health

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## Abstract

Rising greenhouse gas levels heat the earth's surface and alter climate patterns, posing unprecedented threats to planetary ecology and human health. At the same time, obesity, diabetes, and cardiovascular disease have reached epidemic proportions across the globe, caused in part by decreases in physical activity and by over-consumption of carbon-intensive foods. Thus, interventions that support active transportation (walking or cycling rather than driving) and healthier food choices (eating plant-based rather than meat-based diets) would yield health and sustainability "co-benefits." Emerging research suggests that mindfulness-based practices might be effective means toward these ends. At the University of Wisconsin-Madison, we have developed a mindfulness-based group program, *Mindful Eco-Wellness: Steps Toward Healthier Living*. Loosely based on the Mindfulness-Based Stress Reduction course, our curriculum teaches mindfulness practices in tandem with sustainability principles, following weekly themes of Air, Water, Food, Energy, Transportation, Consumption, Nature Experience, and Ethics. For example, the "Air" class offers participants practice in guided breath meditations while they learn about the benefits of clean air. The theme of "Food" is presented through mindful eating, accompanied by educational videos highlighting the consequences of food production and consumption. "Transportation" includes walking/movement meditations and highlights the health benefits of physical activity and detriments of fossil-fueled transportation. Pedagogical lessons on energy, ecological sustainability, and the ethics of planetary health are intertwined with mindful nature experience and metta (loving-kindness) meditation. Curricular materials, including teaching videos, are freely available online. Pilot testing in community settings (n = 30) and in group medical visits (n = 34) has demonstrated feasibility; pilot data suggests potential effectiveness. Rigorous evaluation and testing are needed.

## Keywords

carbon footprint, co-benefits, health behavior, meditation, mind body therapies, planetary health, sustainability, wellness program

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## Background

Climate change results from the increasing concentrations of atmospheric greenhouse gases (GHGs) that trap solar heat and drive changes in weather patterns, posing increasing threats to human health.[1-3] Over 60% of global GHG emissions result from individual, household, and societal behavioral patterns.[4] In general, socioeconomically advantaged individuals, communities, and nations are disproportionately responsible for these GHG emissions and have the greatest capacity for reducing their carbon footprints.[5-7] Many of the changes needed to mitigate climate change and reduce carbon footprints will also yield health "co-benefits." At the population level, for example, using solar and wind rather than fossil fuels to produce electricity will reduce air pollution and also ameliorate a host of pulmonary and cardiovascular maladies.[8] At the individual level, walking or bicycling instead of driving, using stairs rather than elevators, and transitioning towards plant-based diets will help reduce carbon emissions while promoting healthy physical activity and nutrition.[9-11] According to Project Drawdown, the world's leading organization for ranking climate solutions, reducing food waste and adopting plant-rich diets are the top two strategies for significantly reducing carbon emissions worldwide, with focusing on transportation solutions following close behind (e.g., public transit, walkable cities, bicycle infrastructure).[12]

Supporting mental health is another important pillar in this effort because, as the World Health Organization (WHO) acknowledges, "there can be no health or sustainable development without mental health."[13] Additionally, engagement in activities aimed at supporting both personal health and environmental sustainability could help to ameliorate eco-anxiety (distress or worry about ecological collapse from climate change) while fostering well-being through stress reduction and an increased sense of purpose.[14-16]

Despite obvious potential advantages, to our knowledge, there are no well-developed and validated behavioral change programs aimed directly at health and sustainability co-benefits. Existing health behavior programs tend to be disease-specific rather than preventive, usually do not consider whole-person biopsychosocial health, and rarely include environmental sustainability as a major goal. Conversely, programs targeting pro-environmental behaviors tend to ignore health and usually focus on single domains such as household energy, personal transportation, purchasing, or recycling. There is both need and opportunity to develop programs aimed at helping people to improve personal health while also contributing to environmental sustainability. The purpose of this paper is to review relevant literature, contribute to the broader theoretical discussion in this area, and report on initial findings of a mindfulness-based eco-wellness intervention that we developed.

## Mindfulness

According to a widely cited definition,[17] *mindfulness* refers to nonjudgmental awareness of bodily sensations, thoughts, and emotions as they occur in the present moment. At least 336 randomized controlled trials (RCTs) (N = 30,483) have assessed the effects of mindfulness training programs on various health domains.[18] Dozens of meta-analyses report that mindfulness-induced reductions in perceived stress, anxiety, depression, and pain are both statistically and clinically significant, with effect sizes as large or larger than those from conventional treatments, such as antidepressants or cognitive behavioral therapy.[18] Potential mechanisms by which mindfulness might improve health outcomes include strengthening attentional awareness, improved emotional regulation, and conscious alignment of choices and behaviors with personal values.[19-21] One of the most widely studied programs, Mindfulness-Based Stress Reduction (MBSR), includes 8 weekly group visits and teaches mindfulness meditation practices.[22]

## Mindfulness and Pro-Environmental Behavior

Over the past two decades, scholars have discussed the possibility that mindfulness practices might enhance pro-environmental behaviors (PEBs): human behaviors that benefit the environment, often assessed as carbon footprint reduction.[23-26] While various potential mechanisms linking mindfulness and PEBs have been considered, empirical evidence is primarily observational (i.e., non-experimental).[27] In 2005, Brown and Kasser (N = 206; N = 220) reported that dispositional mindfulness was positively associated with self-reported PEBs ($\beta = .44$; $P < .001$).[28] In 2009, Amel et al reported a survey of 100 adults using Baer's Five Facet Mindfulness Questionnaire (FFMQ)[29] that found that the acting-with-awareness facet was positively associated with PEBs ($\beta = .37$; $P < .001$).[24] Two studies by Hunecke and Richter using the FFMQ (N = 310; N = 560) reported that mindfulness and acting-with-awareness predicted sustainable food consumption ($\beta = .11$, $P = .04$), and that both personal and social norms were involved with setting intentions and then achieving sustainable diets.[30,31] Barbaro and Pickett conducted two studies (N = 360; N = 296) that found positive associations between self-reported PEB and mindfulness ($\beta = .19$; $P < .01$; $\beta = .30$, $P < .01$), with analyses suggesting that connectedness to nature might mediate these relationships.[23] A survey conducted by Jacob et al (N = 829) reported positive associations between mindfulness meditation, subjective well-being, and PEBs including recycling, household purchasing, and sustainable eating practices (*r's* ranging from .15 to .37; $P < .01$).[32] In a study among 300 participants with varying levels of mindfulness practice, Thiermann et al. found a dose-dependent relationship between mindfulness practice and pro-environmental attitudes and practices,

including concern for the environment, connectedness with nature, and especially with reduced animal protein consumption.[33] As a final example, in surveys in 3 countries (N = 703, N = 414, N = 336), Kaur and Luchs found that mindfulness practice predicted both socially conscious and frugal consumption (βs = .43, .44; $P < .001$), and that altruistic and environmental values mediated those relationships.[34] [Table 1].

Despite promising correlational evidence, experimental (i.e., interventional) studies assessing the effects of mindfulness training on PEBs are limited. Geiger et al. reported two small RCTs (N = 60, N = 71) in which participants were randomized to either an 8-week program based on MBSR or waitlist control.[36] Outcome data "suggested a decline of materialistic value orientations in both samples" but failed to demonstrate significant changes in PEBs.[36] Ray et al. reported a small RCT (N = 97) testing a 4-week online meditation program among students who were randomized to either hearing nature sounds or musical sounds during meditation; while both groups displayed increases in mindfulness, connectedness to nature, and self-reported PEB, the group hearing nature sounds showed significantly higher levels of nature connectedness after the intervention.[43] In a 125-person RCT designed to test the effects of mindfulness training on general well-being, Riordan et al. reported that randomization to either MBSR or a structurally matched "health enhancement program" active control led to substantive increases in self-reported PEB and sustainable well-being relative to waitlist, but with no differences between the active intervention groups.[44]

## Mindfulness for Physical Activity

Evidence exists that mindfulness training can positively influence physical activity, which could include less carbon-dependent modes of transportation such as walking and cycling. A 2018 systematic review by Schneider et al. found 20 observational studies that together identified a consistent positive relationship between dispositional mindfulness and regular physical activity.[47] The largest mindfulness-based RCT on this topic (N = 324) found small improvements in exercise capacity ($d = .22$ [95% CI .05 to .39]), systolic blood pressure ($d = .19$ [.03 to .36]), mental functioning ($d = .22$ [.05 to .38]), and depressive symptoms ($d = .18$ [.02 to .35]).[37] The second largest RCT randomized 168 patients with fibromyalgia to MBSR or active control, and found no difference in accelerometer-assessed physical activity.[38] Most of the other 12 RCTs reported positive results, but all had <100 participants and were otherwise limited in methodological quality. Schneider et al. concluded that programs targeting psychological factors related to physical activity were most likely to be effective.[47] However, none of these trials looked at movement in terms of active transportation or sustainability.

## Mindfulness for Healthy Eating

Transitioning towards a plant-based diet could improve population health while also substantively reducing carbon footprint.[10,48] For instance, 1 kg of nuts has an estimated carbon footprint of about 0.3 kg of carbon dioxide equivalent, whereas a kilo of beef can have a carbon footprint of >50 kg of $CO_2$ equivalent.[49] Evidence suggests mindfulness may support positive dietary change. For example, in 2019, Fuentes et al conducted meta-analysis of 10 RCTs mostly low-to-moderate quality, reporting modest weight loss effects of mindfulness-based eating strategies compared to nonintervention controls (−.348 kg [−.591 to −.105]).[35] A 2021 meta-analysis by Mercado et al 4[42] ($k = 12$, N = 632) reported that mindfulness-based dietary interventions increase mindful eating and decrease binge-eating, but their analyses did not confirm effects on body weight. The SHINE trial, perhaps the most rigorous mindfulness-for-dietary intake RCT, randomized 194 adults with obesity (BMI 30-45) to a 5.5-month diet and exercise program, with or without additional mindfulness training. Reporting their data in two publications, Mason et al 4[40,41] found increased mindful eating, decreased consumption of sweets, and improved fasting glucose in the mindfulness group, factors which predicted weight loss at 12 months.[40] The two-site MB-EAT trial reported by Kristeller et al. randomized 150 overweight or obese adults to three groups: mindfulness training, cognitive behavioral therapy, or wait-list control.[39] Both active interventions showed benefits relative to control, with trends favoring mindfulness. The authors reported that mindfulness practice uptake predicted improvements on several variables, including weight loss ($r = −.38$, $P < .05$).[39]

## Mindfulness for Both Diet and Exercise

A 2019 meta-analysis of 125 observational studies (N = 31,697) by Sala et al found positive associations between mindfulness and physical activity ($r = .09$ [.06 to .12]) and healthy eating ($r = .14$ [.08 to .19]), as well as sleep and alcohol and drug use.[46] Additionally, a 2017 meta-analysis of 12 mindfulness RCTs by Ruffault et al (N = 626) found reductions in both impulsive eating as well as positive effects on physical activity ($d = .42$ [.15 to .69]). They also reported that longer follow-up periods were associated with greater weight loss,[45] unlike most interventions where effects tend to dissipate over time.

## Connectedness with Nature as Catalyst Towards Behavior Change

Observational evidence suggests that mindful experience and appreciation of nature and natural environments is associated with psychological and physical health.[50-52] Several small RCTs suggest that nature immersion may positively influence both personal health and PEBs.[53-56] A 2019 systematic

**Table 1.** Empiric Studies of Mindfulness for Improving Eco-wellness Behaviors.

| Author & Year | Study Design Sample | Intervention/ Predictor | Mediator(s) | Outcome | Coefficient/Effect Size |
|---|---|---|---|---|---|
| Amel et al 2009[24] | Survey n = 100 | Mindful attentiveness | | PEB | β = .37; *P* < .001 |
| Barbaro et al 2016[23] | Surveys | Mindfulness | PEB | | Study 1: mindfulness and PEB: β = .19, t(309) = 3.45, *P* < .01; mindfulness and connectedness to nature (β = .28, t(332) = 5.21, *P* < .01; controlling for mindfulness, connectedness to nature and PEB (β = .29, t(308) = 5.11, *P* < .01). |
| | Study 1: n = 360; Study 2: n = 296 | | Nature Connectedness | | Study 2: mindfulness and PEB (β = .30, t(296) = 5.43, *P* < .01), mindfulness and connectedness to nature (β = .42, t(296) = 8.01, *P* < .01; controlling for mindfulness, connectedness to nature and PEB (β = .51, t(296) = 9.59, *P* < .01) |
| Brown & Kasser 2005[28] | Two surveys | Mindfulness | | Subjective Well-Being | In both studies, subjective well-being was associated with self-reported ecological responsible behaviors. Structural equation models found that mindfulness helped to explain that relationship. |
| | n = 206 students aged 10-18. n = 200 adults | | | PEB "Ecological Responsible Behavior" | β = .44, t = 4.01, *P* < .001 |
| Fischer et al 2017[25] | Systematic review 7 studies | Mindfulness | | Sustainable consumption | Inconclusive findings |
| Fuentes et al 2019[35] | Meta-analysis | Mindful/intuitive eating strategies | | Weight loss | −.348 kg [95% CI: −.591 to −.105] *P* = .005 |
| | 10 RCTs N = 716 | | | Body mass index | −.137 kg/m$^2$ [−.365 to .091] *P* = .240 |
| | | | | Waist circumference | −.358 cm [−.916 to .200] *P* = .209 |
| Geiger et al 2019[36] | Two surveys n = 60, n = 71 | Mindfulness-based stress reduction | | PEB | r = .30, *P* = .001 |
| | | | | Sustainable nutrition behavior | r = .31, *P* < .001 |
| | | | | Sustainable clothing consumption positively | |
| Gotink et al 2017[37] | RCT n = 324 | Mindfulness | | Exercise capacity | d = .22 [95% CI: .05 to .39]) |
| | | | | Systolic blood pressure | d = .19 [ 95% CI: .03 to .36]) |
| | | | | Mental functioning | d = .22 [.05 to .38]) |
| | | | | Depressive symptoms | d = .18 [95% CI:0.02 to .35] |
| Grossman et al 2017[38] | RCT n = 168 women with fibromyalgia | MBSR | | Objective measures of cardiovascular and respiratory functioning | NS |
| Hunecke & Richter 2019[30] | Survey n = 310 | Mindfulness and acting-with-awareness | Personal and social norms | Sustainable food consumption | β = .11, *P* < .05 |
| Jacob et al 2009[32] | Survey n = 829 | Mindfulness | | Subjective well-being and PEB | r's ranging from .15 to .37; *P* < .01 |

*(continued)*

**Table 1.** (continued)

| Author & Year | Study Design Sample | Intervention/ Predictor | Mediator(s) | Outcome | Coefficient/Effect Size |
|---|---|---|---|---|---|
| Kaur & Luchs 2022[34] | Three surveys n = 703, n = 414, n = 336 | Mindfulness | Altruistic and environmental values | Socially conscious and frugal consumption | βs = .43, .44; $P < .001$ |
| Kristeller 2014[39] | RCT n = 150 | Mindfulness-based eating awareness training | | Weight loss | r = −.38; $P < .05$ |
| RCT | | | | Binge-eating disorder | Significant reduction in those meeting binge-eating disorder criteria 4-months post-intervention in those receiving mindfulness training compared to those in cognitive behavioral therapy or wait-list control groups ($P < .05$) |
| Mason et al 2016[40] | RCT n = 194 | Mindfulness training | Reward-driven eating | Weight loss | Mindfulness (relative to control) participants had significant reductions in reward-driven eating at 6 months (post-intervention), which, in turn, predicted weight loss at 12 months. Post-intervention reward-driven eating mediated 47.1% of the total intervention arm effect on weight loss at 12 months [β = −.06, SE(β) = .03, $P = .030$, 95% CI (−.12, −.01) |
| Mason et al 2016[41] | RCT n = 194 | Mindfulness training | | Mindful eating and maintenance of fasting glucose | Mindfulness intervention participants showed greater increases in mindful eating from baseline to 12 months, $P = .036$, diff = −.11, 95 % CI (−.22, −.01) |
| Mercado et al 2021[42] | Meta-analysis 12 studies n = 632 | Mindfulness | | Body mass<br>Binge eating | NS<br>SMD = −6.49 [−10.80 to −2.185] |
| Ray et al 2021[43] | RCT n = 97 | Meditation with or without nature sounds | Connectedness to nature<br>Mindfulness | PEBs | "Mindfulness had a direct relationship with the change in PEBs (c' = .21, t = 2.68, $P < .01$)… Change in mindfulness predicted change in connectedness to nature (a1i = .38, t = 2.66, $P < .01$), and change in connectedness to nature predicted change in pro-environmental behavior (bi = .17,t = 3.00, $P < .01$)." |
| Richter & Hunecke 2020[31] | Survey n = 560 | Mindfulness and acting-with-awareness | Personal and social norms | Sustainable food consumption | β = .157, $P = .046$ |
| Riordan et al 2022[44] | RCT n = 156 | MBSR | Long-term meditation training | PEB; environmental attitudes; sustainable well-being | Cohen's d ranged from .63 ($P < .01$) to −.14 |
| Ruffault 2017[45] | Meta-analysis 12 studies n = 626 | Mindfulness | Weight loss and related health behaviors | Physical activity<br>Binge eating | d = −1.13 [−1.93 to −.33])<br>d = −.90 [−1.52 to −.28]) |
| Sala 2020[46] | Meta-analysis 125 samples n = 31,697 | Mindfulness | | Physical activity<br>Healthy eating | r = .09 [.06 to .12]<br>r = .14 [.08 to .19] |

*(continued)*

**Table 1.** (continued)

| Author & Year | Study Design Sample | Intervention/ Predictor | Mediator(s) | Outcome | Coefficient/Effect Size |
|---|---|---|---|---|---|
| Schneider et al 2018[47] | Systematic review 40 studies (20 cross-sectional, 20 interventional) | Dispositional mindfulness | Stress, psychologic flexibility, negative affect, shame, satisfaction, state mindfulness | Physical activity | Quantitative findings not described well "Mindfulness-based interventions were more likely to be successful if they were physical activity-specific and targeted psychological factors related to physical activity." |
| Thiermann et al 2020[33] | Cross-sectional study n = 300 | Mindfulness and acting-with-awareness | Connectedness to nature | Pro-environmental attitudes & practices; personal health; greenhouse gas emissions, land occupation, and water use | Diet-related environmental impacts were lower for meditators compared to non-meditators F(8, 358) = 2.65, *P* = .008, ηp2 = .056; small statistically significant differences between meditation groups on GHG emissions, F(2, 290) = 4.051, *P* = .018; ηp2 = .027; small significant main effect of practice level on land use impacts F(2, 290) = 3.860, *P* = .022; ηp2 = .026; groups showed a small significant difference in water use, F(2, 290) = 4.032, *P* = .019; ηp2 = .027 |

MBSR = Mindfulness-Based Stress Reduction.
NS = Non-Significant.
PEB = Pro-Environmental Behavior(s).
RCT = Randomized controlled trial.
SMD = Standardized Mean Difference.

review and meta-analysis of 75 correlational studies and 17 experimental research projects reported "a strong and robust association" between nature experience and PEB ($r$ = .37 [.34 to .40]), with the RCT evidence suggesting a causal connection ($d$ = .21 [.07, .35]).[57] A separate 2022 meta-analysis of six RCTs (n = 332) testing forest-based therapies against control conditions reported that overall effect size (Hedges $g$) was 1.25 [.93 to 1.57].[58] A cross-sectional study (N = 300) by Thiermann et al reported that the potentially causal relationship of "mindful compassion practice on greenhouse gas emissions from animal-protein consumption is partially mediated by [connectedness with nature]."[33] It should be noted that most studies are limited by design, outcomes measured, sample size, and other factors; much more work will need to be done before findings can be considered robust.[27] From the eco-wellness perspective, experiencing and appreciating natural environments is likely both a cause and consequence of good health (and a reflection of privilege) and is deeply tied to the motivations and facilitators surrounding PEBs.

## Mindful Eco-Wellness: Steps Towards Healthier Living

***Mindful Eco-Wellness*** was first conceived in 2014 and described in our first publication in 2016, initially called Mindful Climate Action (MCA).[59] Loosely based on MBSR, this mindfulness-based eco-wellness training occurs in a group format and includes weekly 2-h classes and suggested home practices. The curriculum, teaching videos, and associated materials are freely available to the public (https://www.fammed.wisc.edu/mca/). From the beginning, this mindfulness-based eco-wellness program was aimed at deepening awareness and insight, which are hypothesized to support more thoughtful choices and behaviors regarding both health and sustainability.[27,59] The first pilot study (2016; N = 16) demonstrated the feasibility of interweaving mindfulness training with sustainability education [Table 2].[60] While participant attendance and enthusiasm were high, it proved challenging to coordinate the timing of mini-lectures by University of Wisconsin-Madison environmental scientists. This led to the development of short videos narrated by the scientists and focused on the weekly ecological themes of Air, Water, Food, Energy, Transportation, Consumption and Ethics. These videos were then used by mindfulness instructors in a second pilot trial (2019; N = 15).[61] In both community-based pilots, we assessed the feasibility of collecting data on active transport, automobile use, dietary intake and general health. Automobile transport, dietary intake, and household energy use (utility records) were used to calculate carbon footprint [Table 3]. Both pilots were aimed at qualitatively assessing and refining the program's curriculum and delivery rather than efficacy-testing.

Following pandemic-associated interruptions, four more small pilots were conducted as group medical visits (GMVs),

**Table 2.** Community-Based Pilot Studies and Group Medical Visits to Date.

| | Pilot 1 (2017) | Pilot 2 (2019) | GMV 1 (2022) | GMV 2 (2023) | GMV 3 (2023) | GMV 4 (2023) |
|---|---|---|---|---|---|---|
| Group size, Gender | n = 16, (9 F, 7 M) | n = 14, (14 F, 0 M) | n = 8 (5 F, 3 M) | n = 8 (5 F, 3 M) | n = 9 (5 F, 4 M) | n = 9 (5 F, 3 M) |
| Age Range | 30-63 | 30-68 | 50-76 | 53-81 | 48-83 | 25-72 |
| Dietary Intake | ASA24 | ASA24 | None | None | None | None |
| Movement | Moves app; Odometer readings | Moves app; Odometer readings | None | None | None | None |
| Sustainability | Carbon Footprint from Auto travel, Diet, Gas & electric | Carbon Footprint from Auto travel, Diet, Gas & electric | Pro-envrionmental behavior checklist | Pro-envrionmental behavior checklist | Pro-envrionmental behavior checklist | Pro-envrionmental behavior checklist |
| Self-report Health | CES-D, SPS-6, PSS-10, SF-36 | SF-36 | Feeling Loved | Feeling Loved | Feeling Loved | Feeling Loved |
| Questionnaires | | | PROMIS-29 | PROMIS-29 | PROMIS-29 | PROMIS-29 |

ASA-24 = Automated Self-Administered dietary assessment tool; CES-D = Center for Epidemiologic Studies depression scale; PROMIS-29 = Patients Reported Outcomes general health; PSS-10 = Perceived Stress Scale; SF-36 = Medical Outcomes Study Short Form general health; SPS-6 = Stanford Presenteeism Scale; Feeling Loved was developed and validated by Barrett et al (2018).

**Table 3.** Sustainability-Related Findings from Two Pilot Studies.

| | Mean | S.D. | Range | Range of Underlying Data |
|---|---|---|---|---|
| [a]Dietary [CF kg $CO_2$e] | 1.6 | .87 | .9 to 3.0 | 89 to 230 food items logged |
| [b]Walk [mi/wk] | 1.55 | .86 | .48 to 2.42 | .61 to 2.87 hr/wk |
| [b]Bicycle [mi/wk] | 1.28 | 1.45 | .01 to 2.82 | .00 to 1.09 hr/wk |
| [b]Motor vehicle [mi/wk] | 94.0 | 62.7 | 34.7 to 185.2 | 2.85 to 11.5 hr/wk |
| [c]Motor vehicle [kg$CO_2$e] | 1.6 | 1.0 | .25 to 3.34 | |
| [d]Electricity [12 mo] | 331 | 87 | (equivalent to 3.0 metric tons $CO_2$e per year) | |
| [e]Gas [12 mo] | 50 | 25 | (equivalent to 3.5 metric tons $CO_2$e per year) | |

[a]CF = carbon footprint shown in estimated kg $CO_2$. Range also shown in number of food items logged on ASA24 dietary assessment tool.
[b]Personal transport data in miles/week, from smart phone GPS (*Moves app*). Range also shown in hours/week.
[c]Motor vehicle CF calculated using vehicle make-year-model and miles driven at: https://www.fueleconomy.gov.
[d]Household electricity in kilowatt hours per month.
[e]Household gas in therms/month over a year of utility records. Data previously reported in: Grabow M, Bryan T, Checovich M, et al. "Mindfulness and climate change action: A feasibility study" *Sustainability*. 2018;10(5).[60]

led by Dr. Barrett and a mindfulness instructor (psychotherapist Beth Wortzel for three of these). We changed the name of the course from *Mindful Climate Action* to *Mindful Eco-Wellness: Steps towards Healthier Living* because the phrase "climate action" was considered by some to be politically charged or off-putting. For these group visits, patients in the UW Health system with at least one mental health condition (anxiety, depression, stress, insomnia) or cardiovascular risk factor (elevated glucose, cholesterol, blood pressure, body weight) attended *Mindful Eco-Wellness* sessions for either 6 or 7 weeks. The length was reduced from 8 to either 6 or 7 weeks to reduce burden on patients and their health insurance; exit interviews found that the longer 7-week format was preferred. Following feedback from participants in the two community-based pilots and first GMV, we replaced the earlier Consumption theme with Nature Connectedness, accompanied by mindfulness-in-nature practices. Each patient chose their own health goals, typically to eat better and exercise more. Reducing stress and supporting interpersonal relationships also were named by participants as reasons for attending the course. These sessions were considered healthcare rather than research, with clinical notes in the electronic health record and billing to insurance where appropriate. Attendance was high with 7 to 9 patients attending the first class and 5 to 7 completing the GMV series. Pre-to-post trends in self-reported health and pro-environmental behaviors were positive [Table 4]. While statistical testing comparing pre- (initial) and post- (follow-up) PROMIS-29 scores did find statistically significant improvements in four domains (anxiety, depression, physical health, fatigue), issues including multiple comparison,

**Table 4.** Initial (pre) and Follow-Up (post) Scores for PROMIS-29, Feeling Loved, and Pro-environmental Behavior Checklist.

| Instrument | Measure | Initial Mean (SD) | Follow-up Mean (SD) | ↑ = improve ↓ = worsen | Score Range | *P*-value |
|---|---|---|---|---|---|---|
| PROMIS-29[a,62] | | | | | | |
| | Physical Function | 16.85 (4.64) | 17.38 (4.57) | ↑ | (4, 20) | .02 * |
| | Anxiety | 6.52 (2.62) | 5.64 (1.93) | ↑ | (4, 20) | .02 * |
| | Depression | 6.54 (3.6) | 5.31 (2.15) | ↑ | (4, 20) | .003 ** |
| | Fatigue | 9.65 (3.85) | 8.73 (4.1) | ↑ | (4, 20) | .049 * |
| | Sleep Disturbance | 7.91 (2.94) | 8.09 (2.97) | ↓ | (4, 20) | 0.7 |
| | Social Roles | 14.92 (3.97) | 16 (4.2) | ↑ | (4, 20) | .13 |
| | Pain | 7.85 (4.18) | 7.12 (4.11) | ↑ | (4, 20) | .12 |
| | Global Pain | 2.46 (1.98) | 2.15 (1.99) | ↑ | (0, 10) | .32 |
| | Physical Health Summary (T)[b,c] | 47.14 (9.99) | 50.47 (9.94) | ↑ | (20, 80) | |
| | Mental Health Summary (T)[b,c] | 50.29 (7.71) | 53.64 (6.76) | ↑ | (20, 80) | |
| Feeling Loved[63] | | | | | | |
| | How loved do you feel? | 86.54 (20.68) | 86.85 (16.65) | ↑ | (0, 100) | .87 |
| | How much do you love yourself? | 77.84 (20.28) | 81.48 (17.73) | ↑ | (0, 100) | .23 |
| | Global Score | 352.04 (76.62) | 359.8 (64.45) | ↑ | (0, 400) | .23 |
| Pro-Environmental Behaviors[d,e,64] | | | | | | |
| | Minimize air conditioning in summer | 3.22 (.94) | 3.5 (.99) | ↑ | (1, 5)[e] | .14 |
| | Set thermostat lower in winter | 4.33 (.69) | 4.39 (.7) | ↑ | (1, 5) | .72 |
| | Use high-efficiency light bulbs (LED) | 4.37 (.6) | 4.53 (.7) | ↑ | (1, 5) | .38 |
| | Turn off electronics when not in use | 4.21 (.79) | 4.21 (.71) | | (1, 5) | 1 |
| | Air dry laundry instead of dryer | 2.79 (1.08) | 2.74 (1.33) | ↓ | (1, 5) | .67 |
| | Use automobile only when needed | 3.58 (1.02) | 3.84 (1.12) | ↑ | (1, 5) | 0.2 |
| | Replace driving with biking, walking, bus, carpool | 2.06 (.87) | 2.28 (.89) | ↑ | (1, 5) | .22 |
| | Reduce highway speed | 3.22 (.94) | 3.28 (.96) | ↑ | (1, 5) | .79 |
| | Reduce air travel | 3.53 (1.28) | 3.76 (1.03) | ↑ | (1, 5) | .16 |
| | Reduce meat consumption | 3 (1.03) | 3.06 (.94) | ↑ | (1, 5) | .77 |
| | Reduce dairy consumption | 2.95 (.85) | 3.11 (1.1) | ↑ | (1, 5) | .42 |
| | Eat organic food | 3 (.88) | 3 (.82) | | (1, 5) | 1 |
| | Eat local food | 3.22 (.55) | 3.39 (.7) | ↑ | (1, 5) | .33 |
| | Eat food from a home garden | 2.83 (1.1) | 2.78 (1.06) | ↓ | (1, 5) | .58 |
| | Reduce food waste | 3.89 (.99) | 4 (1) | ↑ | (1, 5) | .69 |
| | Compost food scraps | 2.79 (1.65) | 2.95 (1.72) | ↑ | (1, 5) | .08 |
| | Check for leaky faucets and fix/replace | 4.26 (1.15) | 4.32 (.82) | ↑ | (1, 5) | .75 |
| | Install high-efficiency/low-flow shower heads | 4.03 (1.23) | 4 (1.06) | ↓ | (1, 5) | .86 |
| | Water your lawn and plants less | 3.56 (.92) | 3.67 (1.28) | ↑ | (1, 5) | .71 |
| | Reduce water waste | 3.97 (.95) | 4.17 (.92) | ↑ | (1, 5) | .09 |
| | Reduce purchasing | 3.5 (.52) | 3.81 (.54) | ↑ | (1, 5) | .06 |
| | Repair and reuse rather than replace | 3.79 (.85) | 3.89 (.88) | ↑ | (1, 5) | .49 |
| | Buy clothes second-hand/used/vintage | 3.06 (1.3) | 3.28 (1.41) | ↑ | (1, 5) | .16 |
| | Use reusable bags when shopping | 3.63 (.96) | 4 (.88) | ↑ | (1, 5) | .07 |
| | Use reusable bottles and cups for water, coffee, tea, etc. | 4.11 (.68) | 4.11 (1.02) | | (1, 5) | 1 |
| | Avoid single use plastic | 3.78 (.65) | 3.78 (.81) | | (1, 5) | 1 |
| | Reduce/avoid aerosol use | 3.84 (.83) | 3.84 (.76) | | (1, 5) | 1 |
| | Educate oneself about the environment | 4.05 (.85) | 4.11 (.81) | ↑ | (1, 5) | .77 |
| | Discuss environmental topics | 3.95 (1.03) | 3.89 (.99) | ↓ | (1, 5) | .67 |

*(continued)*

**Table 4.** (continued)

| Instrument | Measure | Initial Mean (SD) | Follow-up Mean (SD) | ↑ = improve ↓ = worsen | Score Range | *P*-value |
|---|---|---|---|---|---|---|
| | Vote and engage with political representatives | 4.17 (1.04) | 4.06 (1) | ↓ | (1, 5) | .71 |
| | Engage in environmental activism | 2.79 (.98) | 2.95 (.78) | ↑ | (1, 5) | .42 |
| Pro-Environmental Behaviors[d] | **% (n)** | **% (n)** | | | | |
| | Do a home-energy audit and insulate where needed | 75% (28) | 83.33% (18) | ↑ | (Yes, No) | .76 |
| | Install solar or geothermal | 3.7% (27) | 11.76% (17) | ↑ | (Yes, No) | .68 |
| | Purchase a hybrid or electric vehicle | 29.63% (27) | 26.32% (19) | ↓ | (Yes, No) | 1 |
| | Make your current vehicle last as long as it can | 96.3% (27) | 100% (18) | ↑ | (Yes, No) | 1 |

[a]N ranges from 23 to 26 due to individual scores missing.
[b]PROMIS-29 Physical Health Summary (T) and Mental Health Summary (T) were calculated following Spritzer and Hays.
[c]Summary (T) includes the following domains: Physical Function, Fatigue, Sleep Distribution, Pain composite (Pain + Global Pain), and Emotional composite (Anxiety + Depression); calculated with different coefficients for each respective Summary (T).
[d]N ranges from 16-19 and only includes cohorts 2-4; cohort 1 used different version of PEB and data could not be included.
[e]Pro-Environmental Behavior (PEB) questionnaire adapted from Recurring Pro-Environmental Behavior Scale[64]; Response range: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Usually, 5 = Always.
Statistical Methods: Student T-tests were used to assess differences in initial and follow-up PROMIS-29, Feeling Loved, and PEB for continuous measures and a test of proportions were used to assess differences in binary measures in the PEB survey. Following Hays and Spritzer,[62] a composite score was created for PROMIS-29 Physical Health and Mental Health. All analyses were done in R (v. 4.1.1; R Core Team 2021). A *P*-value of < .05 was considered statistically significant.

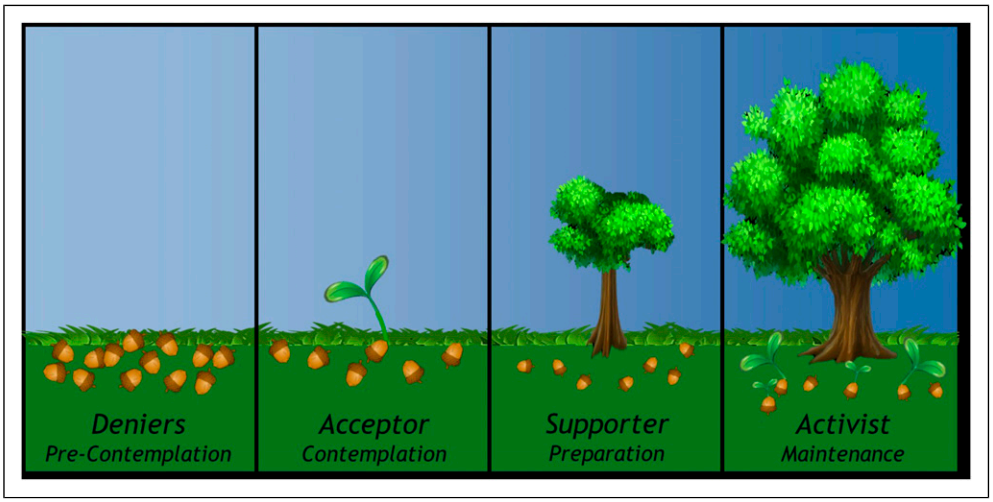


**Figure 1.** Stages of change for climate-related pro environmental behaviors.

lack of control condition, and potential social desirability bias all limit interpretation. Nevertheless, we are encouraged by the finding that nearly all trends were in positive directions. In summary, while the small sample size and uncontrolled design of these six pilots made it impossible to assess efficacy, we were able to demonstrate acceptability of *Mindful Eco-Wellness* delivered in these settings, as well as feasibility of recruiting participants, intervention delivering, and obtaining relevant outcome data. We also used participant feedback to refine the course's curriculum, which can be delivered in 6-, 7-, or 8-week format.

## Conceptual Framework

The behavior change conceptual framework most relevant to this research is the transtheoretical (stages of change) model developed by Prochaska and Diclemente, which proposes that intentional behavior change occurs by using cognitive

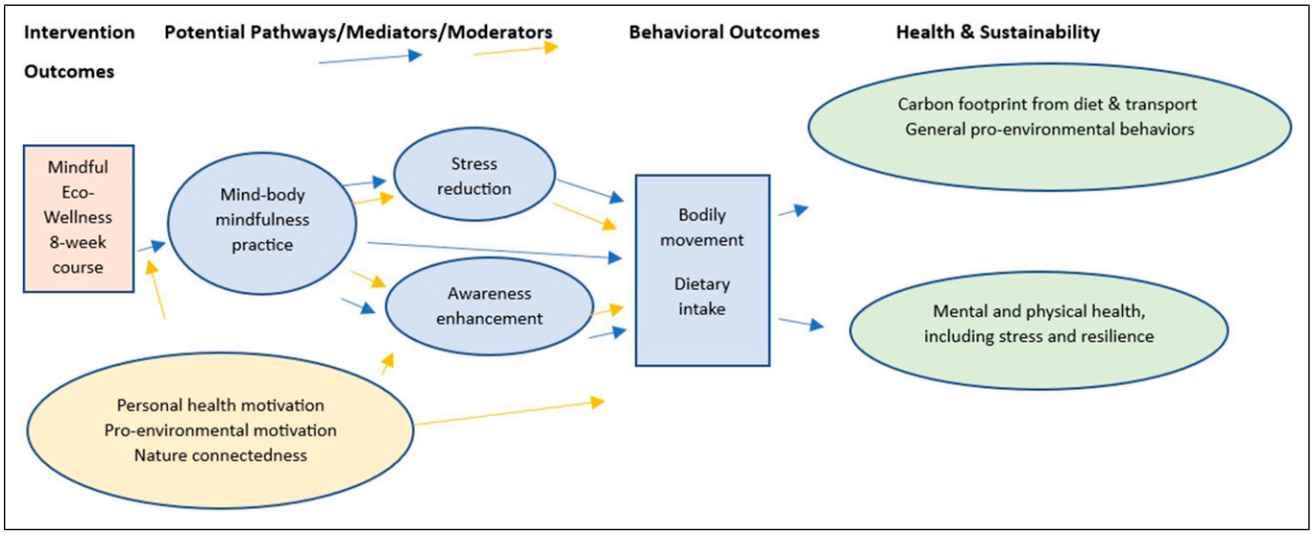


**Figure 2.** Conceptual framework.

and behavioral processes to transition through stages until the desired behavior is achieved and maintained.[65-67] For eco-wellness, the behavioral change model is conceptualized as bi-axial, with desired changes conceptualized on both personal health and pro-environmental axes. For example, a person could be in pre-contemplation or contemplation stages regarding health behaviors (e.g., eating too many sweets or processed foods, and not exercising), but already in action or maintenance stage of PEB change (e.g., recycling regularly and reducing driving). In general, most participants who take part in this research will likely be in contemplation or preparation stages on both axes when they enroll. If the *Mindful Eco-Wellness* class is successful, participants will transition into action or even maintenance stages on both health and PEB axes. While we have not rigorously assessed stage of change in our work so far, this could be done, perhaps with interviews, focus groups, and statistical models based on data from validated self-report instruments.[68]

[Figure 1] Reproduced from Barrett et al 2016[59]

*Mindful Eco-Wellness* is a multi-component intervention that could influence several health and sustainability outcomes through several different mechanisms. To reduce this multiplicity, we are currently focusing on two health behaviors (dietary intake and physical activity) and two potential pathways (stress reduction and mindful awareness). Dietary intake and bodily movement are central to this model because of the strong impact these behaviors have on both health and sustainability. Stress reduction and awareness enhancement are included because of the many studies implicating these factors as pathways through which people positively change their behaviors. Our conceptual model also considers three potential moderating factors which might predispose people towards mindfulness uptake and behavioral change: (i) health-enhancement motivation, (ii) pro-environmental motivation, and (iii) connectedness with nature. Figure 2 shows this conceptual framework.

## Conclusions, Discussion, Next Steps

In the face of rising chronic illness and the unfolding climate crisis,[1-3] we urgently need effective interventions to help people improve choices and behaviors that benefit both individual and planetary health. Ecological and individual wellness are inseparably intertwined and should be jointly targeted. Yet to our knowledge, despite many examples of behaviors supporting both individual wellness and planetary health, no such interventions have been rigorously developed and tested. The *Mindful Eco-Wellness* program is one such effort that has shown encouraging potential across several pilot studies and is now ready for rigorous experimental testing.

Nevertheless, we must be careful not to overgeneralize intervention design strategies, targeted outcomes, or conceptual models across populations. In its present form, the *Mindful Eco-Wellness* program was piloted among individuals from majority white cultures whose environmental impacts are, on average, more substantial than those of minoritized or low income populations.[4-7] Those with higher socioeconomic status have greater capacity to make the behavioral and lifestyle modifications necessary to reduce their carbon footprints. Thus, although targeting these populations first may enhance environmental and public health benefits, the results may not generalize to less advantaged groups who are at higher risk from climate change, and who would benefit most from health-enhancement activities.[69-72]

If the *Mindful Eco-Wellness* program is to be effective across diverse populations, it will likely need substantive adaptation. Nondominant groups will benefit from tailored interventions that account for broader systemic forces such as

public policy, macroeconomics, and systemic racism and classism, all of which can heavily constrain individual behaviors and choices. For example, access to healthy foods and active transportation options is limited for low income and minoritized groups.

In addition, people who identify as Black, Indigenous, or People of Color (BIPOC) may hold cultural-ecological worldviews different from the dominant white culture. Accounting for such differences will be critical for the success of *Mindful Eco-Wellness* or similar programs. For example, some BIPOC individuals may question the program's emphasis on personal behaviors, considering that low income and minoritized communities are neither equally responsible for nor equally empowered to influence the societal level changes needed. Other BIPOC individuals may be motivated to participate based on more pragmatic factors (e.g., to reduce chronic disease or food insecurity, lower healthcare costs, benefit one's community, restore ancestral lands), whereas individuals from the dominant majority may be motivated by more abstract motivations such as mitigating climate change, feeling healthier, or experiencing less eco-anxiety.

Future research projects will need to examine such issues using a variety of study designs, including observational and experimental approaches that use quantitative, qualitative, or mixed methods. Also worth investigating is whether an emphasis on interpersonal ethics and prosociality[73] might increase adherence or effectiveness of the intervention, given that pro-environmental behavior has the potential to reduce the suffering of others.

At this stage, we aim to test the current format of the intervention in a population-based sample using randomized experimental design and a combination of self-report and objective behavioral measures (e.g., wearable fitness trackers, vehicle odometer readings, mobile phone location data mapped to roads, walkways, and biking paths). Computer-assisted analysis of meal photographs could support dietary intake assessment and reduce participant burden.[74] Biometrics such as body weight, cholesterol, blood sugar, and blood pressure also could be employed.

In summary, while the importance of developing a science of behavioral eco-wellness - defined as *the study of how individual choices, behaviors, and habits impact both personal health and environmental sustainability*[10] - is undeniable, efforts in this direction have only just begun.

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