Using Chromopressure to Reduce Fatigue among Women Workers in the Indonesian Food Industry: A Quasi-experimental Study

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Abstract: Fatigue is a symptom of tiredness that is related to an exertion of body metabolism. This complaint is the most challenging problem experienced by food industry workers in Indonesia. Therefore, a specific intervention preventing the long-term effect of fatigue is needed in this population. The purpose of this quasi-experimental study was to examine the initial use of chromopressure to reduce fatigue among food industry women workers. Chromopressure is a combination of chromotherapy and acupressure. Chromotherapy is a visible spectrum or colors of electromagnetic radiation to cure diseases. This is the first known study to examine the effect of chromopressure on fatigue. Three food industries were selected in the study. A total of 59 participants were recruited by using purposive and quota sampling. The intervention group (n = 30) received chromopressure for 30 minutes and usual care, but the control group (n = 29) only received usual care. Instruments used to collect the data were UNIMMA Work Fatigue Instrument, Nordic Body Map, and blood cortisol measurement. Descriptive statistics and independent t-test were applied for data analysis. The significance level of 0.05 was considered for hypothesis testing.

The findings confirmed that chromopressure combined with usual care is more effective in reducing fatigue than the usual care. Furthermore, the participants felt comfortable when they received the intervention during the study. This therapy may help the nurses working in the community in terms of fatigue intervention, however further testing of the chromopressure instrument is required. This is a limited product, and the role of government and the health industry is essential to increase the testing, production and distribution in the worker population.

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Introduction

Fatigue is a sign of tiredness and weakness as a result of the exertion of body metabolism.[1] The estimated amount of fatigue is 7%-45% worldwide.[2] Fatigue impacts both physical and cognitive functioning, for example, chronic fatigue syndrome (CFS), overtraining

syndrome, endocrine diseases, and even immunity disorders.[3] These conditions are considered to be differential diagnoses, and the treatments depend on the clinical symptoms. Several studies highlight that fatigue negatively influences people's health-related quality of life, leading to them to overestimate disease severity.[4] In addition, fatigue is a potential health problem causing work accidents and losses to the company production.[5]

In the worker populations, fatigue after completing working hours indicates an imbalance between demands and the worker's capacity.[6] A study supported that high intensity of workload and job demands contribute to fatigue, significantly hampering work performance.[7] In addressing safety concerns associated with worker performance, it is critical to design an intervention within tolerable worker performance limits. This can be achieved by a comprehensive understanding of how a particular intervention may reduce work fatigue among workers. Various studies have been conducted to deal with fatigue. However, none of those studies examining the effectiveness of chromopressure (combination of chromotherapy and acupressure) among women workers in the food industry in Indonesia. In this study, chromopressure is an instrument that delivers a wave using an electrode similar to acupressure and provides color therapy, particularly green color, to heal physical problems within the body.

Women workers are prevalent in low-income or developing countries[38] as they help their husbands in terms of financial support for the family. In addition, the Javanese culture emphasizes that work in the industry (e.g., food industry) is suitable for women, not men.[41] Finally, we hypothesized that this therapy would benefit against fatigue and contribute to the development of nursing science in the future.

Review of Literature

Fatigue is defined as an overwhelming feeling of tiredness, lack of energy, and exhaustion causing problems in performing voluntary, specific tasks.[8] Studies document that a total of 23%-40% of workers suffering a high intensity of fatigue and more than 60% are slightly tired after a working day.[6, 9] Unmanaged shift work may also lead to fatigue among workers.[10] In addition, workload, lack of social support, and unprotected work has indirect and direct effects on fatigue.[11] Fatigue, as a common symptom in primary care, negatively impacts work performance along with relationships.[12] Beyond perceptions and human feelings, fatigue may reduce cognitive function, physical and psychological performance.[13]

Fatigue can be solved by managing lifestyle issues, and treatment of physical and mental conditions.[14] Specific nursing interventions can be developed according to the population being cared for and the type of disease.[15] A nursing study reported an intervention for fatigue involved physical exercise, psycho-education, acupressure, relaxation, distraction, cognitive behavioral therapy, energy conservation, and activity management.[16] In addition, studies have been conducted to deal with people with fatigue. For example, Christi et al. suggested consuming additional supplements made from bananas as these have adequate nutrients to supply energy for people with fatigue.[17] A recent investigation highlighted the use of a fan, adjusting the light intensity and position during working time.[18] Physical exercise three times a week was also suggested to reduce fatigue, as exercise increases the production of endorphins, oxygen in the blood and energy levels.[19]

Acupressure is known as an adjunctive therapy for fatigue. Theoretically, acupressure is a form of touch therapy using pressure with thumbs or fingertips to stimulate discrete points on the body to reduce symptoms and mitigate tension and pain.[20] This therapy has also been highlighted in a critical nursing review.[21] Several studies also emphasized the effectiveness of using acupressure to relieve fatigue in cancer.[22] The acupressure increases serenity, improves mood, and reduces depression in fatigue.[23] An Indonesian study documented that acupressure helps reducing low

back pain by increasing secretion of endorphins.[24] Another study used a Pain Digital Acupressure (PDA) instrument to reduce work fatigue among workers **(Figure 2)**.[25] Setyowati et al.[25] explained that PDA stimulated the endorphins and made a person more comfortable.

Furthermore, color therapy (chromotherapy that uses green color) can reduce fatigue, stress, anxiety and improve mood.[26,27] Green color promotes comfort, relaxation and reduces stress.[36] Furthermore, green light stimulates the growth hormones and improves muscle strength, bones, and the immune system.[36] The green color diffuses into the skin and tissue causing the nervous system to increase the production of cortisol.[36] The lead researcher developed an instrument to reduce the clinical symptoms of the worker population. This instrument uses several electrodes that are put into the skin. In addition, this instrument also provides color therapy (chromotherapy) that uses colors (e.g., green color) spreading from the instrument. The light that appears may give relief for fatigue **(Figure 1)**. Application has been made to approve the instrument for a patent (No. S00201910353). The researchers are now waiting for the approval letter from the Indonesia Government.

Figure 1. The use of Chromopressure

Figure 2. Pain Digital Acupressure (PDA)

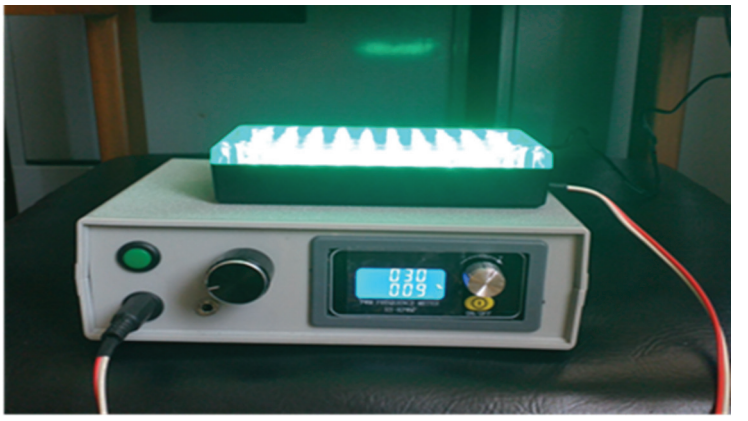

Figure 3. Chromopressure

A literature review reported the effectiveness of using acupressure and color therapy separately to reduce fatigue. As mentioned in the studies above, there are several methods of fatigue intervention, but none of the studies combined acupressure and color therapy among industrial food workers in Indonesia. It is not surprising that many industrial workers try to avoid invasive and pharmacological methods of fatigue pain relief, and, vice versa, seek complementary therapies with minimal side effects. For this reason, this study examined the initial use of chromopressure to reduce fatigue among food industry workers.

Study Aims

The study aimed to examine the initial use of chromopressure to reduce fatigue among women workers in the food industry in Indonesia, and assessed the intervention during and after the data collection process. Ideally, there should be no associated side effects after receiving the therapy. It is expected that the findings of this study will reduce the prevalence of fatigue and help the community nurses to provide complementary therapies against work fatigue.

Method

Design: A quasi-experimental study with a 2-group, pretest-posttest design was used. We followed the Transparent Reporting of Evaluations with Non-randomized Designs (TREND) statement Checklist for reporting this non-RCT study.

Study Setting: Three food industries located in one city in Indonesia were purposively selected because many workers complain of fatigue. Also, the locations were far between the selected industries so as to prevent contamination between groups. Even though the industries provide health insurance, there is no specific treatment when fatigue complaints are reported. The workers were only suggested to take a break, drink water, eat some food then continue working.

Sample size: The inclusion criteria were female, aged >18 years old, able to read and willing to provide informed consent. Meanwhile, the exclusion criteria were chronic illness (diabetic foot ulcers, integument disorders, cardiovascular and pulmonary diseases) and other diseases that potentially hampered data collection. A total of 60 women workers in the three food industries were the population of the study. The first industry had 12 employers; the second had 18, and the third had 29. We used total employers as we have the limitation of financial hindrances to increase the sample size. However, we did not randomize to determine the intervention and control groups in the settings. The researcher used simple numbering of participants into groups, number 1-30 (intervention group, first and second industry) and number 31-60 (control

group, third industry). However, during the study process, one participant in the control group dropped out due to a fear of blood tests.

Ethical considerations: The study was approved by the ethics committee of Universitas 'Aisyiyah Yogyakarta, Indonesia (No.1631/KEP-UNISA/V/2020). Also, informed consent was obtained from all participants before data collection. Participants' rights were protected throughout the study, and their names and other relevant identity were removed for publication purposes and privacy protection.

Research instruments: Instruments were comprised of two parts. Part 1 was the instruments for data collection, and Part 2 was the intervention.

Part 1: There were four instruments; participants' demographic form and three outcomes measures of UNIMMA Work Fatigue Instrument (UWFI), Nordic Body Map (NBM) and a blood cortisol test. These three instruments were chosen by considering the accuracy and feasibility to be used by community nurses.

A *participants' demographic form* collected specific data of age, married status, address and work length.

Three instruments were used to measure the outcomes. The *UNIMMA Work Fatigue Instrument (UWFI)* was developed in the Indonesian language by the researchers in a previous study.[28] The instrument was established to test physical, psychological and emotional fatigue[43] and consists of the following dimensions: 1) mood changes (seven items on irritability, anxiety, not caring, feeling sad, feeling failed, lack of motivation, and hopelessness), 2) difficulty thinking (two items, feeling confused and having difficulty concentrating), 3) sleep problems, one item on feeling tired after waking up, 4) physical changes consisting of six items such as changes in appetite and digestive problems: nausea, vomiting, diarrhea, headache/dizziness, chest palpitations, decreased/weight gain, and pain in some parts of the body, and 5) the effect on work consists of three items such as being less able to interact with other people, lack of self-confidence and inability to meet deadlines/targets. The UWFI had previously been confirmed for its internal reliability (Cronbach's alpha = 0.877).[28] Questions are rated on a 4-point rating scale (0 = never, 1 = less than once a month, 2 = at least once a month, 3= at least once a week, and 4 = every day). The total score ranges from 0-76 with categorization as follows: mild fatigue (0-19), moderate fatigue (20-38), severe fatigue (39-57) and very severe (58-76). However, this instrument describes fatigue in general and is not specific as Nordic Body Map (NBM).

Therefore, the NBM was used in this study to examine fatigue and had already been translated into Indonesian.[29] The instrument is used to describe the location of fatigue in the human body, for example, fatigue in the foot or hand or a body organ. The instrument consists of 28 questions that two operators must assess. The NBM was confirmed for its internal reliability (Cronbach's alpha = 0.926).[42] The questions are rated using a 4-point rating scale (1 = no pain, 2 = mild pain, 3 = moderate pain, and 4 = severe pain). The total score ranges from 28-112 with categorization as follows: mild pain (28-56), moderate pain (57-84), and severe pain (85-112).

Blood cortisol test: A laboratory analyst collected the blood before and after the intervention. The normal range is between 6 and 23 micrograms per decilitre (mcg/dL). This measurement was chosen because of its sensitivity to evaluate stress due to fatigue.[44] The laboratory technician annually calibrates the laboratory testing instrument to ensure the result is in the acceptable range.

Part 2 Instrument for intervention. The chromopressure instrument was used for the intervention group to reduce fatigue **(Figure 2).** This instrument has several electrodes that are placed on a person's skin and through these a green color spreads to skin and body to produce a calming effect during intervention. For this pilot study, the instrument was used for 30 minutes to evaluate the effectiveness.

The intervention group received chromopressure for 30 minutes daily along with usual care. The lead researcher and a research assistant administered the chromopressure in a small room **(Figure 1).** The control group only received the usual care (advice to take a break, having a meal, and have no medication).

Data collection: The data collection process was conducted for one month during November 2020 by the lead researcher and three research assistants who received training before the study onset. The outcomes were evaluated by using UWFI, NBM, and cortisol test measures immediately after the intervention.

Data analysis: Descriptive statistics were used to analyze the demographic data of the participants. Chi-square was used to determine the difference between observed and expected data due to chance, or if due to a relationship between the variables. Fisher's exact test was used to determine if there were non-random associations between two categorical variables. The distribution of data was tested for normality by using the Kolmogorov-Smirnov test. The data were normally distributed and met the assumptions. The difference in data between the intervention and comparison groups was analyzed using the independent t-test.

Results

The demographic data of the participants are presented in **Table 1.** There was no statistical difference in age between the two groups. Most of the participants in the intervention group were married, unlike in the control group where most were unmarried. Related to the length of employment, participants in both groups had worked for more than five years. According to the score of Kolmogorov-Smirnov, the data in both groups were normally distributed.

Table 1. Characteristics of participants

No	Variable	Intervention Group (*n*:30)				Control Group (*n*:29)				*p*
		Mean	SD	*n*	%	Mean	SD	*n*	%	
1	Age	45.83	10.09			43.38	12.99			0.420[a]
2	Marital status									0.424[b]
	a. Married			28	93.3			4	13.8	
	b. No married			2	6.7			25	86.2	
3	Length of employment (years)	5.32	2.79			5.48	4.38			0.862[a]

[a] One-Way Anova; [b] Fisher's exact test

For the effectiveness of chromopressure, it was found that the mean score of fatigues as measured by UWFI, NBM, and blood cortisol level were not significantly different between the two groups at the beginning, but at immediately at post-intervention, the mean score of both UWFI, NBM, and blood cortisol level in the experiment group were significantly lower than that of the control group.

Regarding the blood cortisol test score, most participants in the intervention group had decreased cortisol (n = 23; 76.7%) compared with the control group (n = 16; 55.1%). This decrease means that the cortisol was lower after the intervention. There were no participants with a stable cortisol level in both groups. In addition, the mean difference before and after the intervention of all three variables in the experiment group was significantly higher than the control group. **(Table 2)**

Table 2. Comparison of mean and difference before and after of fatigue and blood cortisol level between the experiment and the control groups

Variable	Time of measurement	Intervention Group (n = 30)		Control Group (n = 29)		Mean Difference (95% CI)	*p*
		Mean	SD	Mean	SD		
Fatigue							
WIFI	Before	40.13	9.07	44.10	6.74	-3.97 (-8.14 0.205)	0.062
	After	34.73	7.49	48.66	7.64	-13.92 (-17.87 -9.88)	< 0.001
	Difference before and after	5.4	4.68	-4.55	4.26	9.95 (7.62 12.29)	< 0.001

Table 2. Comparison of mean and difference before and after of fatigue and blood cortisol level between the experiment and the control group (Cont.)

Variable	Time of measurement	Intervention Group (n = 30)		Control Group (n = 29)		Mean Difference (95% CI)	*p*
		Mean	SD	Mean	SD		
NBM	Before	35.80	8.43	35.76	7.77	0.04 (-4.19 4.27)	0.984
	After	30.60	4.51	39.72	7.97	-9.12 (-12.48 -5.76)	< 0.001
	Difference before and after	5.20	5.01	-3.97	4.60	9.17 (6.66 11.67)	< 0.001
Cortisol	Before	64.08	25.09	58.74	19.92	5.35 (-6.49 17.18)	0.370
	After	51.62	17.30	65.40	24.32	-13.78 (-24.75 -2.80)	0.015
	Difference before and after	12.46	17.01	-6.66	21.65	19.12 (8.78 29.97)	< 0.001

*UWFI: Unimma Work Fatigue Instrument

*NBM: Nordic Body Map

Discussion

In this study, chromopressure effectively reduced fatigue among women workers in the food industry in Indonesia. Chromopressure may help to maintain vital energy (Qi) and thus reduce fatigue. This is the first known study to examine the effect of chromopressure on fatigue. Therefore, the mechanism of fatigue reduction in this study is based on the literature discussing the effectiveness of acupressure and chromotherapy. Each therapy has benefits to reduce fatigue by increasing the secretion of endorphins. The instrument generated a square wave of 20 Hz (Steady State Visually Evoked Potentials / SSVEP) that provided comfort to the participants.[30] Also, SSVEP is appropriate and has a moderate vibration that comforted participants during the data collection process. Physiologically, acupressure helps to naturally release endorphins healing the body from pain and blocking the signals that perceive pain.[31] β-endorphins are opioid substances and have an analgesic effect due to eliminating pain sensation by reducing the number of nociceptive action potentials. A study described endorphins as a "happiness hormone" consisting of at least 20 different endorphins.[32] A systematic review supported that acupressure is helpful to relieve tiredness as well as fatigue.[33] The study emphasized that acupressure stimulates meridians, a network of energy in the body, to increase the flow of Qi, subsequently reducing the symptom experience.[33] During the intervention, there was an improvement in cortisol level as this hormone is associated with fatigue. We hypothesized that chromopressure inhibited the stress hormone leading to fatigue.

Our study revealed that the use of color therapy (chromotherapy) is effective in relieving fatigue. However, studies that supported this finding are limited and study only investigated the role of color therapy in a disease.[34] Also, color therapy was used to relieve anxiety.[27] We then highlighted that color therapy increases the function of the hypothalamus to produce melatonin that leads to a calming effect and fatigue reduction. A study evidenced that each color has a certain frequency wavelength and energy that has a function to relieve pain or fatigue.[35] In our study, we used a green color as it creates a sense of comfort, relaxation, reduces stress, balance, and calm emotions.[36] Furthermore, green light therapy stimulates the formation of growth hormones and strengthens muscles, bones, and the immune system. During the study, we also observed that the participants in the intervention group looked comfortable and even giving a smile to the researcher. Thus, the use of chromopressure seems to be helpful, even though the evidence to support the finding is limited and even unexplored.

Limitations and Recommendations for Future Research

The study generated positive outcomes for the population. However, there were limitations during the research process. For example, chromopressure was only implemented for 30 minutes for one time in the intervention group due to the time limit and permission from the manager of the industries. As a consequence, the long-term effect of chromopressure was unable to be found. Even though the chromopressure was applied shortly for one time, this therapy consisted of two interventions (acupressure and chromotherapy) that may have many benefits in reducing fatigue.

Furthermore, the study involved only females; thus, the effect of these therapies on male participants was unknown. In addition, the International Labor Organization (ILO) reported that informal workers are dominated by females in low-income or developing countries (e.g., Indonesia)[38] and interestingly, the Javanese culture work in the food industry is suitable for females. However, access to buy the chromopressure instrument is still limited, and the lead researcher developed this instrument. The wide size of PAD electrodes potentially spread the wave generated from that instrument to the different acupressure points.

As the study is a pilot of experimental design, using a small sample size, we found several limitations. There may be an increase in the standard error, increasing the chance of assuming as true a false result, a wide 95% CI, and an imprecise estimate of the effect leading to a no firm conclusion.[39, 40] Further testing of the effectiveness in a larger group using randomized controlled trial with long-term follow-up is needed.

Conclusion and Implications for Nursing Practice

Chromopressure, as combination therapy of acupressure and color therapy, effectively reduces fatigue among women industry workers in Indonesia. However, this pilot study only assessed the short-term use of these therapies. Further study is needed to evaluate the different types of work (e.g., office workers) over a longer duration. This therapy may help the community nurses in providing fatigue intervention. Performing regular follow-up visits is recommended for effective long-term fatigue management.

However, our findings can help the community nurses to improve their intervention and increase the opportunities for chromopressure use in the community practice, for example, assessing the sleep quality. Evidence highlighted that fatigue is caused by poor sleep quality.[37] As a consequence, health education in sleep management is essential for preventing fatigue. Also, community nurses may encourage people to use chromopressure therapy but only after further testing shows that this therapy has effective outcomes in other populations.

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การใช้รงคบำบัดผ่านคลื่นไฟฟ้าเพื่อลดความเหนื่อยล้าของกลุ่มพนักงานสตรีในอุตสาหกรรมอาหารของอินโดนีเซีย: การศึกษากึ่งทดลอง

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บทคัดย่อ:

ความเหนื่อยล้าเป็นอาการของความเหน็ดเหนื่อยเมื่อยล้าที่เกี่ยวข้องกับการใช้พลังงานในกระบวนการเมแทบอลิซึมของร่างกาย ความไม่สุขสบายนี้เป็นปัญหาที่ท้าทายที่พนักงานในอุตสาหกรรมอาหารในประเทศอินโดนีเซียประสบ ดังนั้น การบำบัดที่จำเพาะในการป้องกันผลกระทบระยะยาวของความเหนื่อยล้าของประชากรกลุ่มนี้จึงเป็นสิ่งจำเป็น วัตถุประสงค์ของการวิจัยกึ่งทดลองครั้งนี้เป็นการศึกษา ผลเบื้องต้นของวิธีการบำบัดแบบผสมผสานที่เรียกว่า “โครโมเพรสเชอร์” (chromopressure) ในการลดความเหนื่อยล้าของพนักงานสตรีในอุตสาหกรรมอาหาร โครโมเพรสเชอร์เป็นวิธีการผสมผสานระหว่างรงคบำบัด (หรือการบำบัดด้วยสี) ผ่านคลื่นไฟฟ้าทางขั้วอิเล็กโทรดที่คล้ายกับการกดจุด รงคบำบัดเป็นสเปกตรัมที่มองเห็นได้หรือสีของรังสีแม่เหล็กไฟฟ้าที่ใช้ในการรักษาโรค การวิจัยครั้งนี้เป็นงานแรกที่ศึกษาผลของโครโมเพรสเชอร์ต่อความเหนื่อยล้า โดยโรงงานอุตสาหกรรมอาหาร 3 แห่งได้รับการคัดเลือกในการวิจัยและคัดเลือกผู้เข้าร่วมวิจัยทั้งหมด 59 ราย โดยใช้การสุ่มตัวอย่างแบบเจาะจงและตามโควตา กลุ่มทดลอง (30 ราย) ได้รับโครโมเพรสเชอร์เป็นเวลา 30 นาทีร่วมกับได้รับการดูแลตามปกติ แต่กลุ่มควบคุม (29 ราย) ได้รับการดูแลตามปกติเท่านั้น เครื่องมือที่ใช้ในการรวบรวมข้อมูล ได้แก่ UNIMMA Work Fatigue Instrument, Nordic Body Map, และการวัดค่าคอร์ติซอลในเลือด ในการวิเคราะห์ข้อมูล ใช้สถิติบรรยายและ independent t-test ในการทดสอบสมมติฐาน กำหนดระดับนัยสำคัญทางสถิติเท่ากับ 0.05

ผลการวิจัยพบว่า การใช้โครโมเพรสเชอร์ร่วมกับการดูแลตามปกติมีประสิทธิผลในการลดความเหนื่อยล้ามากกว่าการดูแลตามปกติ นอกจากนี้ ผู้เข้าร่วมวิจัยรู้สึกสุขสบายเมื่อได้รับการบำบัดในระหว่างการวิจัย การบำบัดนี้น่าจะช่วยพยาบาลที่ทำงานในชุมชนในด้านการบำบัดความเหนื่อยล้าได้ อย่างไรก็ตาม ยังมีความจำเป็นที่จะต้องมีการทดสอบคุณสมบัติของเครื่องมือโครโมเพรสเชอร์เพิ่มเติม เครื่องมือนี้ยังมีจำกัด ดังนั้น รัฐบาลและอุตสาหกรรมด้านสุขภาพจึงควรมีบทบาทสำคัญในการทดสอบ การผลิต และการกระจายในประชากรกลุ่มพนักงานโรงงานต่อไป

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คำสำคัญ: การกดจุด รงคบำบัด โครโมเพรสเชอร์ ภาระงานของบุคคล ความเหนื่อยล้า พนักงานสตรี

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