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Capoeira: hypothesis on health rehabilitation and quality-of-life maintenance

Sérgio R. Moreira[1,2,3,4*], Ariel Custódio de Oliveira II[1,2], Anderson Armstrong[4,5,6]

SUMMARY

OBJECTIVE: The aim of this work was to present hypotheses supporting capoeira as an activity aimed at health rehabilitation and maintenance of quality of life.

METHODS: Capoeira players (n=245), residing in Brazil and abroad, were evaluated for quality of life (physical, social, psychological, and environmental domains from WHOQOL-bref). The capoeira players' quality of life scores were compared to normative values and reference values in martial arts. Besides, studies involving capoeira (Medline/Embase/Cinahl/SportDiscus) were also reviewed for health-related hypotheses, describing population, intervention, comparator, and outcome.

RESULTS: There are hypotheses on capoeira improving health through (1) body composition, addressed by two studies investigating waist circumference, bone, and muscle mass; (2) functional capacity, investigated by three studies considering performance variables; (3) metabolism, in two studies demonstrating triglycerides and blood glucose reduction, and an enhancement of anaerobic glycolysis; and (4) cardiovascular parameters, addressed by two studies highlighting an increase in maximal oxygen consumption, heart rate, and rate of pressure product reduction, as well as an increase in parasympathetic activity at rest. The sample of this study had higher quality of life scores when compared to normative values for Brazilians, similar quality of life when it comes to social relationships, higher quality of life in the psychological and environmental domains, and lower quality of life in the physical domain when compared to practitioners of other combat sports/martial arts.

CONCLUSION: An analysis of the impacts of capoeira resulted in hypotheses on the rehabilitation of players' biological health. Although the individuals were evaluated within the pandemic period, their quality of life domains were similar or superior to normative or reference values found by studies from before the pandemic.

KEYWORDS: Martial arts. Health. Quality of life.

INTRODUCTION

Capoeira, which is an athletic performance system consisting of attack and defense[1], is, perhaps, the most original manifestation of body culture in Brazil. Due to its motor demands, capoeira is a complex sport that requires coordination and body expression, and it is supposed to involve capacities in its practice such as strength, resistance, flexibility, power, and agility[2].

Given the widely acknowledged relationship between well-being and physical performance[3], players need to be fully aware of their health condition and quality of life (QoL)[4]. The perception of a better QoL has been associated with performance in physical activities[5]. Furthermore, aging has its impacts on physical performance, which could negatively affect individuals' health and QoL, especially in conditions of physical inactivity[6]. In contrast, studies involving experienced capoeira players have shown that both men[7] and women[8] have reduced performance declines with age. Such results suggest that the pattern of reduction in capoeira players' performance with aging, associated with other benefits from the practice of capoeira[9-11], may be related to health variables and the practitioners' QoL.

Studies evaluating QoL in capoeira players and associating it with a strategic practice focused on health are still necessary, aiming at contributing to technical, scientific, and cultural perspectives related to helping in the control and treatment of diseases based on the Brazilian fighting art capoeira. Thus, the objective of this work was to present hypotheses supporting capoeira as an activity aimed at human health rehabilitation and maintenance of QoL. Therefore, applied studies involving

[1]Universidade Federal do Vale do São Francisco, Postgraduate Program in Physical Education – Petrolina (PE), Brazil.
[2]Universidade Federal do Vale do São Francisco, Tutorial Education Program in Physical Education – Petrolina (PE), Brazil.
[3]Associação Brasileira de Apoio e Desenvolvimento da Arte-Capoeira – Rio de Janeiro (RJ), Brazil.
[4]Universidade Federal do Vale do São Francisco, Postgraduate Program in Health and Biological Sciences – Petrolina (PE), Brazil.
[5]Universidade Federal do Vale do São Francisco, College of Medicine – Petrolina (PE), Brazil.
[6]Universidade do Estado da Bahia, Graduate Program in Human Ecology – Salvador (BA), Brazil.
*Corresponding author: sergio.moreira@univasf.edu.br
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capoeira players were analyzed in the generation of health-oriented hypotheses. The work also investigated the QoL profile of capoeira players in comparison to the normative values of Brazilians and practitioners of other combat sports/martial arts.

METHODS

Study design and ethical aspects

A cross-sectional study of the QoL domains of capoeira players was carried out, and evidence was reviewed for hypotheses supporting capoeira in human health. The recruitment of volunteers took place between January 22, 2021, and February 21, 2021 (pandemic period). Data collection was carried out remotely, with questionnaires made available on the Google Forms platform. Links were sent through email using a contact list from the Associação Brasileira de Apoio e Desenvolvimento da Arte Capoeira. The research was approved by the Research Ethics and Deontology Committee of the Universidade Federal do Vale do São Francisco (UNIVASF) under protocol number: 3.576.805 (CAAE: 18145719.5.0000.5196) and is in accordance with Normative Act no. 466/12 of the National Health Council.

Participants

Capoeira players of both sexes living in Brazil and abroad participated in the study (Table 1). Sample calculation was performed

Table 1. Characterization of capoeira practitioners as a function of graduation technical level (n=245). Data collected during the COVID-19 pandemic.

	General	Technical level				
		Graduate I (n=96)	Graduate II (n=61)	Instructor (n=54)	Professor (n=26)	Master (n=08)
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
Sex						
Male	192 (78.4)	70 (72.9)	53 (86.9)	40 (74.1)	23 (88.5)	6 (72.0)
Female	53 (21.6)	26 (27.1)	8 (13.1)	14 (25.9)	3 (11.5)	2 (25.0)
Capoeira training						
Weekly frequency						
<2 times	11 (4.5)	6 (6.3)	2 (3.3)	2 (3.7)	1 (3.8)	0 (0.0)
2 times	59 (24.1)	28 (29.2)	13 (21.3)	13 (24.1)	4 (15.4)	1 (12.5)
3 times	100 (40.8)	39 (40.6)	25 (41.0)	22 (40.7)	11 (42.3)	3 (37.5)
4 times	42 (17.1)	12 (12.5)	16 (26.2)	5 (9.3)	6 (23.1)	3 (37.5)
≥5 times	33 (13.5)	11 (11.5)	5 (8.2)	12 (22.2)	4 (15.4)	1 (12.5)
Classes duration						
30–45 min	8 (3.3)	4 (4.2)	1 (1.6)	1 (1.9)	1 (3.8)	1 (12.5)
46–60 min	56 (22.9)	27 (28.1)	14 (23.0)	10 (18.5)	3 (11.5)	2 (25.0)
61–90 min	122 (49.8)	43 (44.8)	32 (52.5)	29 (53.7)	14 (53.8)	4 (50.0)
>90 min	59 (24.1)	22 (22.9)	14 (23.0)	14 (25.9)	8 (30.8)	1 (12.5)
Classes intensity						
Light	4 (1.6)	1 (1.1)	1 (1.6)	2 (3.7)	0 (0.0)	0 (0.0)
Moderate	153 (62.4)	68 (70.8)	36 (59.0)	24 (44.4)	17 (65.4)	8 (100.0)
Vigorous	88 (35.9)	27 (28.1)	24 (39.3)	28 (51.9)	9 (34.6)	0 (0.0)
	Mean±SD (95%CI)	Mean±SD (95%CI)	Mean±SD (95%CI)	Mean±SD (95%CI)	Mean±SD (95%CI)	Mean±SD (95%CI)
Age (years)	38.4±9.6 (37.2; 39.6)	36.0±10.2 (33.9; 38.9)	37.2±9.0 (34.9; 39.5)	38.7±7.3 (36.7; 40.7)	44.0±6.1 (41.5; 46.4)	55.7±3.9 (52.4; 59.1)
Whole practice in the capoeira (years)	20.5±8.8 (19.4; 21.6)	15.0±6.3 (13.7; 16.3)	19.4±5.7 (18.0; 20.9)	24.3±6.8 (22.4; 26.1)	29.0±7.5 (26.0; 32.1)	41.5±5.3 (37.0; 46.0)
Working time in the capoeira (years)	6.9±9.6 (5.7; 8.1)	1.7±4.0 (0.9; 2.5)	3.9±5.5 (2.5; 5.3)	9.0±7.5 (6.9; 11.0)	20.2±7.6 (17.1; 23.2)	35.0±5.8 (30.1; 39.8)

f: absolute frequency; %: relative frequency; SD: standard deviation; CI: confidence interval of 95%.

using G*Power version 3.1.9.2, adopting an effect size of 0.010 for QoL[12], considering an alpha error of 0.05 and statistical power (1–β) of 0.80. A necessary total of 171 individuals was obtained; however, the sample had 245 participants, increasing statistical power (1–β) to 0.93. As inclusion criteria, capoeira players above 18 years old and those who have blue belt level were included. As exclusion criterion, filling out the questionnaires in a wrong, confusing, or incomplete way was considered.

Procedures

To devise the hypotheses, studies on capoeira and/or with individuals exposed to capoeira for a long time were reviewed. The inclusion criterion was based on the analysis of health-related variables. The descriptors ^capoeira^ and ^health^ were used in Medline, Embase, Cinahl, and SportDiscus databases. Population, intervention, comparator, and outcome were considered for composing the results. The hypotheses were devised through the analysis of health variables, and the results were divided by the aspects of (1) body composition, (2) functional capacity, (3) metabolism, and (4) cardiovascular system.

The QoL of study participants was assessed using the WHOQOL-bref[4] questionnaire, assessing the physical, social, psychological, and environmental domains[13]. Each question had scores ranging from 1 to 5 on a Likert-type scale, transformed into a linear scale that ranged from 0 to 100, with "0" representing a lower QoL and "100" representing a higher QoL[13]. Furthermore, the studies by Cruz et al.[13] with normative values of Brazilians and by Schwartz et al.[12] with male combat sports/martial arts practitioners were adopted in the comparisons with the investigated capoeira players.

Statistical analysis

Descriptive statistics were performed with absolute (f) and relative (%) frequency, mean, standard deviation, and confidence interval (95%CI). Levene's test was used to verify homogeneity. Two-way ANOVA with repeated measures and Bonferroni post-hoc test were adopted. The significance level was set at $p<0.05$ using SPSS version 25.0.

RESULTS

Frame 1 presents the studies reviewed and the hypotheses devised. It highlights the results of variables related to health regarding body composition, functional capacity, metabolism, and the cardiovascular system.

Regarding the capoeira players evaluated in this study, it is noteworthy that the general characteristics (Table 1) are similar between men and women in terms of training variables (frequency, intensity, and duration), age, whole practice, and working time ($p>0.05$). There were no significant differences in QoL domains between the different graduation technical levels for both sexes evaluated ($p>0.05$).

The QoL scores of the sample are shown in Table 2 and compared to the normative values of Brazilians[13]. Since the sample of the reference study by Schwartz et al.[12] was composed exclusively of men, the results of the QoL scores of female capoeira players (n=53) were compared only with normative values of Brazilian women[13] and with male capoeira players. There was an effect between groups [$F(4, 7652)=218.20$; $p<0.001$] and interaction group vs. QoL domains [$F(12, 7652)=26.52$; $p<0.001$], where for QoL within the physical domain, male capoeira players had a higher score compared to the normative value of Brazilians ($p<0.001$) and lower compared to practitioners of other fights ($p<0.001$). Regarding the psychological and environmental domains, male capoeira players had higher scores compared to normative values ($p<0.001$) and to practitioners of other combat sports ($p<0.001$). As for the social relationship domain, there was a difference between male capoeira players and Brazilian normative values ($p<0.001$). Furthermore, it was evidenced that female capoeira players had a higher QoL score in the physical domain compared to the normative value of Brazilian women ($p<0.001$), with no difference when compared to the score of male capoeira players ($p=0.999$). Regarding the psychological domain, female capoeira players had a higher score compared to the normative value of Brazilian women ($p<0.001$) and a lower score compared to male capoeira players ($p<0.01$). Regarding the social relationship domain, there was no difference when comparing the scores of female capoeira players to the normative values of Brazilian women ($p=0.094$) and male capoeira players ($p=0.999$). Finally, regarding the environmental domain, female capoeira players had a higher score compared to the normative values of Brazilian women ($p<0.001$), with no difference for male capoeira players ($p=0.999$).

DISCUSSION

The main results evidence capoeira as a possible intervention strategy aimed at human health with hypotheses about improving body composition (waist circumference, bone, and muscle mass), functional capacity, metabolic aspects with chronic reduction in plasma triglycerides and acute reduction in blood glucose, and potentiation of the anaerobic pathway, in addition to improving parameters of the cardiovascular system with increased maximal oxygen consumption, reduced heart rate, and double pressure product at rest and increased parasympathetic

Frame 1. Hypotheses of the possible effects of capoeira on human health regarding body composition, functional capacity, and metabolic and cardiovascular systems.

Study	Population	N/Sex/Age	Intervention or Exposition	Comparator	Outcome
Body Composition					
Nogueira et al.[14]	Young physically active schoolchildren from two schools in Australia	85/M+F/12.3±0.6 years (control group) 155/M+F/12.2±1.0 years (INTERVENTION group)	Capoeira program at school during 9 months, 3 times a week with 10 min each session (movements with upper and lower limbs emphasizing high speed and associated with jumping with medium and high impact)	Comparison with the control school in a school physical education routine paired with the school in the intervention group	**Control group** Waist circumference: Δ=5.9% CBU: Δ=1.4% **Intervention group** Waist circumference: Δ=2.4% CBU: Δ=4.1% *p*<0.05 between groups
Guimarães Almeida et al.[15]	Capoeira players of various nationalities, being athletes at international level	15/M/32.8±7.2 years (light category) 25/M/34.3±5.3 years (medium category) 10/M/36.1±4.8 years (heavy category)	Exposure to capoeira practice: Light category: 20.7±6.2 years Medium category: 21.3±4.6 years Heavy category: 24.3±6.3 years	Assessment and/or comparison between weight categories	**Somatotype:** MESOMORFY predominance in all categories Body fat light category: 9.8±3.4% Body fat medium category: 11.9±3.6% Body fat heavy category: 12.5±5.9% *p*>0.05 for categories in the body fat
Hypothesis: Capoeira protects against increased adiposity, improves bone mass, and promotes body composition with muscle predominance in humans.					
Functional capacity					
Vale et al.[16]	Previously sedentary Brazilian elderly	10/F/67.3±6.6 years (control group) 13/F/69.3±6.4 years (Intervention group)	Capoeira program in a care center for the elderly, during 12 weeks, twice a week with 60 min each session (moderate intensity in the program: 13.3±0.9 a.u. in RPE 6-20)	Comparison with paired control group in anthropometric and cardiovascular characteristics and pre-training functional capacity (p>0.05)	**Control group** GFI: Δ 4 weeks= −6.2% GFI: Δ 8 weeks= −5.2% GFI: Δ 12 weeks= −7.6% **Intervention group** GFI: Δ 4 weeks=17.6% GFI: Δ 8 weeks=28.0% GFI: Δ 12 weeks=29.7% *p*<0.001 between groups
Moreira et al.[17]	Previously sedentary Brazilian adults	08/M+F/27.1±10.5 years (control group) 13/M+F/26.1±7.2 years (intervention group)	Capoeira program in a training center, during 8 weeks, twice a week with 60 minutes each session (moderate intensity)	Comparison with paired control group in anthropometric characteristics and pre-training flexibility (p>0.05)	**Control group** PThf: Δ 8 weeks=5.7% MRhf: Δ 8 weeks=-5.3% **Intervention group** PThf: Δ 8 weeks=46.2% MRhf: Δ 8 weeks=22.4% *p*≤0.01 between groups
Guimarães Almeida et al.[15]	Capoeira players of various nationalities, being athletes at international level	15/M/32.8±7.2 years (light category) 25/M/34.3±5.3 years (medium category) 10/M/36.1±4.8 years (heavy category)	Exposure to capoeira practice: Light category: 20.7±6.2 years Medium category: 21.3±4.6 years Heavy category: 24.3±6.3 years	Assessment and/or comparison between weight categories	**Tests –** Upper limb strength/ abdominal endurance/flexibility: All tests with excellent rating according to normative parameters *p*>0.05 between weight categories in functional capacity tests
Hypothesis: Capoeira promotes general functionality and angular flexibility and maintains human with satisfactory levels of motor performance.					
Metabolism					
Conceição and Moreira[18]	Previously sedentary Brazilian elderly	7/M+F/82.4±13.6 years (control group) 7/M+F/79.4±6.9 years (intervention group)	Capoeira program in a long-stay institution for the elderly, during 12 weeks, twice a week with 60 min each session (light to moderate intensity)	Comparison with a control group paired for age and anthropometry. Total energy intake, as well as for each macronutrient, did not differ within or between groups during the intervention (p>0.05)	**Control group** Plasma triglycerides: Δ 12 weeks= −18% **Intervention group** Plasma triglycerides: Δ 12 weeks= −37% *p*<0.01 between groups

Continue.

Frame 1. Continuation.

Study	Population	N/Sex/Age	Intervention or Exposition	Comparator	Outcome
Moreira et al.[19]	Brazilian capoeira players at recreational level with 10.7±5.8 years of practice in the modality	11/M/33.0±7.3 years	Acute sessions with 90 s of capoeira game, on different days and at three randomized intensities: **1. Angola** (67±12% of maximum HR) **2. Benguela** (82±6% of maximum HR) **3. São Bento** (95±3% of maximum HR)	Acute comparison of the lowest value for blood glucose concentration and the highest value for blood lactate concentration in the recovery period of capoeira sessions	**Angola session*** Blood glucose: Δ= −15.4% Blood lactate: Δ=5.7 mM **Benguela session***† Blood glucose: Δ=−6.8% Blood lactate: Δ=8.3 mM **São Bento session†** Blood glucose: Δ=11.5% Blood lactate: Δ=14.6 mM *p<0.05 for São Bento in glucose †p<0.05 for others in blood lactate
Hypothesis: Capoeira at light and moderate intensities chronically reduces triglycerides and acutely reduces blood glucose. In addition, with a greater intensity of practice in capoeira, greater activation of anaerobic glycolysis occurred, which could be chronically reflected in better indices of anaerobic fitness in humans.					
Cardiovascular system					
Nogueira et al.[14]	Young physically active schoolchildren from two schools in Australia	85/M+F/12.3±0.6 years (control group) 155/M+F/12.2±1.0 years (intervention group)	Capoeira program at school for 9 months, 3 times a week with 10 min each session (movements with upper and lower limbs emphasizing high speed and associated with jumping with medium and high impact)	Comparison with the control school in a school physical education routine paired with the school in the intervention group	**Control group** VO_2max: Δ=0.0% **Intervention group** VO_2max: Δ=7.1% p<0.05 between groups
Moreira et al.[20]	Previously sedentary Brazilian adults	08/M+F/29.6±3.3 years (control group) 10/M+F/25.4±3.3 years (intervention group)	Capoeira program in a training center, during 10 weeks, once a week with 90 min each session (moderate intensity)	Comparison with paired control group in pre-training anthropometric and cardiovascular characteristics (p>0.05)	**Control group** HR: Δ 10 weeks=−0.7% RPP: Δ 10 weeks=−2.3% RRi: Δ 10 weeks=0.9% rMSSD: Δ 10 weeks=2.9% SD1: Δ 10 weeks=6.5% pNN50: Δ 10 weeks=0.3% **Intervention group** HR: Δ 10 weeks=−8.6% RPP: Δ 10 weeks=−12.2% RRi: Δ 10 weeks=10.1% rMSSD: Δ 10 weeks=37.8% SD1: Δ 10 weeks=37.7% pNN50: Δ 10 weeks=96.2% p<0.05 between groups, except to RPP variable which was p=0.06
Hypothesis: Capoeira promotes improvement in parameters of the cardiovascular system and increases aerobic fitness (maximum oxygen consumption) in humans.					

Δ: variation from pre- to post-intervention; CBU: calcaneal bone ultrasound; RPE: rate of perceived exertion; GFI: general functionality index obtained in a battery with five tests of functional capacity specific to the elderly; PThf: passive joint tension in hip flexion; MRhf: maximum joint range in hip flexion; HR: heart rate; RPP: rate pressure product (myocardial overload rate); RRi: absolute mean of R-R interval sets at rest (HR variability); rMMSD: square root of the mean of the sum of the squares of differences between adjacent RRi (parasympathetic activity); SD1: standard deviation of instantaneous beat-to-beat RRi variability (parasympathetic activity); pNN50: RRi pairs count differing by more than 50 ms divided by the total number of RRi and multiplied by 100; VO_2max: maximum oxygen consumption.

Table 2. Normative values for the quality of life domains (WHOQOL-bref) for Brazilian men (n=288) and Brazilian women (n=463), male combat sports/martial arts practitioners (n=922), and male capoeira practitioners (n=192) and female capoeira practitioners in this study (n=53).

	Physical domain	Psychological domain	Social relationship domain	Environmental domain
Normative values of male[a]	60.3±9.9	65.9±10.8	73.50±18.4	62.9±13.8
Normative values of female[a]	57.8±10.5	62.2±12.5	71.9±19.7	59.7±16.2
Male combat sports and martial arts practitioners[b]	75.0±16.0	75.0±12.0	77.0±16.0	65.0±13.0
Male capoeira practitioners	**67.4±9.4***#	**82.4±8.6***#	**78.9±12.5***	**73.8±11.2***#
Female capoeira practitioners	**65.9±9.8***	**75.2±13.2***	**77.2±14.2**	**70.6±14.3***

[a]Cruz et al.[13]; [b]Schwartz et al.[12]. *p<0.001 for significant difference from normative values; #p<0.001 for significant difference from male combat sports/martial arts practitioners. Data are represented as mean±standard deviation.

nervous activity at rest (Frame 1). In addition, it was possible to verify in the sample of capoeira players in this study that, despite the pandemic, the QoL domains presented values similar or superior to other samples of normative or reference studies carried out before the pandemic (Table 2). Such results can be explained by the routine maintained by the sample, in which, although remotely, they kept doing capoeira training. Most of them would do it two to three times a week, in sessions lasting between 46 and 90 min, with moderate intensity (Table 1).

Corroborating the findings of this study, other authors[21] have shown that athletes in combat sports have higher scores in the domains of QoL compared to the general population. In fact, the evaluated sample of capoeira players showed better perceptions in all domains of QoL when compared to the normative values of Brazilians[13], suggesting that capoeira seems to satisfactorily maintain the QoL scores of its players, even in the pandemic period. Besides, although combat sports and martial arts show benefits in the QoL of their practitioners, capoeira seems to have a potentiated effect, with additional benefits in psychological and environmental aspects when compared to other combat sports[12].

From a scientific point of view, Kotarska et al.[22] stated that combat sports/martial arts help develop practitioners' personalities, leading them to an improvement in physical apparatus, mental resistance, and courage and also contributing to attenuating negative emotions. Furthermore, these authors[22] investigated the relationship between QoL and healthy behaviors in 543 Polish individual practitioners of fight and demonstrated positive correlations between practice of fights, health behaviors, and higher QoL scores. These findings, in addition to supporting the relationship between capoeira and the maintenance of QoL (Table 2), reinforce the hypotheses devised in this study (Frame 1). Thus, suggesting capoeira as a form of systematic physical activity, in programs aimed at human health rehabilitation, corroborates other controlled studies adopting conventional physical training (aerobic or resistance), which demonstrated important effects in the treatment of overweight and obesity[23], systemic arterial hypertension[24], and type 2 diabetes associated with functional disability[25].

Regarding the limitations faced by this study, it is important to highlight that the results presented, especially in the QoL of capoeira players, which was evaluated transversally, do not create a cause-and-effect relationship and, therefore, longitudinal studies are recommended for this purpose.

CONCLUSION

This study devised hypotheses on the rehabilitation of biological human health (body composition, functional capacity, and metabolic and cardiovascular systems) through capoeira intervention. In addition, even though QoL was evaluated during the pandemic, capoeira players had higher scores when compared to the normative values of Brazilians outside the pandemic. When compared to practitioners of other combat sports/martial arts, capoeira players showed similar results in the social relationship domain, higher in the psychological and environmental domains, and lower in the physical domain. Finally, longitudinal studies are encouraged to test the hypotheses generated in this study regarding the causal relationship between capoeira and health rehabilitation processes and QoL in different populations, especially individuals with chronic degenerative diseases that involve the aforementioned aspects.

AUTHORS' CONTRIBUTIONS

SM: Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft, Writing – review & editing, Project administration. **AA:** Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft, Writing – review & editing, Project administration. **ACOII:** Data curation, Formal Analysis, Methodology, Writing – original draft.

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