CHERRY EXTRACT ON POST-EXERCISE MUSCLE DAMAGE

EXTRATO DE CEREJA EM DANOS MUSCULARES PÓS-EXERCÍCIO

EL EXTRACTO DE CEREZA DAÑOS MUSCULARES POST EJERCICIO

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ABSTRACT

Introduction: Cherry extract has a high amount of anthocyanins and flavonoids containing antioxidant effects. Its high antioxidant characteristics have been shown to reduce markers of delayed muscle soreness (DOMS) and exercise-induced muscle damage (EIMD) to improve recovery after exercise. Objective: Verify the effects of the cherry extract on post-exercise muscle damage. Methods: Google scholar, Medline, and Scopus were systematically searched until February 2022. The Cochrane Collaboration tool was applied to determine the risks of bias. Results: The results showed that cherry extract administration did not have a decreasing impact on creatine kinase levels overall: (WMD = 12.85 IU. L-1, 95% CI: -35.94, 61.64; P = 0.606). Considerable heterogeneity was observed among the articles (Cochran's Q-test = 990.80, P = 0.000, I2 = 96.7 %). However, there is a significant reducing effect on pain sensation by the consumption of cherry extract (WMD = -6.105 mm; 95% CI: -11.193 -1.017; p = 0.019). Conclusion: Cherry extract consumption effectively reduced late-onset muscle pain among participants in the overall and subgroup analysis. Thus, the cherry extract may be a complementary alternative in recovery after exercise. ***Level of evidence II; Therapeutic studies - Manuscript review.***

Keywords: Fruit Proteins; Soft Tissue Injuries; Creatine Kinase; Meta-Analysis.

RESUMO

Introdução: O extrato de cereja tem uma alta quantidade de antocianinas e flavonóides contendo efeitos antioxidantes. Suas altas características antioxidantes demonstraram reduzir os marcadores de dor muscular retardada (DOMS) e dano muscular induzido pelo exercício (EIMD) para melhorar a recuperação após o exercício. Objetivo: Verificar os efeitos do extrato de cereja nos danos musculares pós-exercício. Métodos: Google scholar, Medline e Scopus foram sistematicamente pesquisados até fevereiro de 2022. A ferramenta de colaboração da Cochrane foi aplicada para determinar os riscos de viés. Resultados: Os resultados mostraram que a administração do extrato de cereja não teve um impacto decrescente nos níveis de creatina quinase em geral: (WMD = 12,85 IU. L-1, 95% CI: -35,94, 61,64; P = 0,606). Uma heterogeneidade considerável foi observada entre os artigos (teste Q da Cochran = 990,80, P = 0,000, I2 = 96,7 %). Porém, há um efeito redutor significativo na sensação de dor pelo consumo de extrato de cereja (WMD = -6,105 mm; 95% CI: -11,193 -1,017; p = 0,019). Conclusão: O consumo de extrato de cereja foi efetivo na redução de dores musculares de início tardio entre os participantes, na análise geral e nos subgrupos. Assim, o extrato de cereja pode ser uma alternativa complementar na recuperação após os exercícios. ***Nível de evidência II; Estudos terapêuticos - Revisão de manuscritos.***

***Descritores*:** *Proteínas de Frutas; Lesões dos Tecidos Moles; Dores musculares; Creatina Quinase; Metanálise.*

RESUMEN

Introducción: El extracto de cereza tiene una gran cantidad de antocianinas y flavonoides con efectos antioxidantes. Se ha demostrado que sus altas características antioxidantes reducen los marcadores de dolor muscular retardado (DOMS) y el daño muscular inducido por el ejercicio (EIMD) para mejorar la recuperación después del ejercicio. Objetivo: Verificar los efectos del extracto de cereza en el daño muscular posterior al ejercicio. Métodos: Se realizaron búsquedas sistemáticas en Google scholar, Medline y Scopus hasta febrero de 2022. Se aplicó la herramienta de colaboración Cochrane para determinar los riesgos de sesgo. Resultados: Los resultados mostraron que la administración de extracto de cereza no tuvo un impacto decreciente en los niveles de creatina quinasa en general: (WMD = 12,85 UI. L-1, IC del 95%: -35,94, 61,64; P = 0,606). Se observó una considerable heterogeneidad entre los artículos (prueba Q de Cochran = 990,80, P = 0,000, I2 = 96,7 %). Sin embargo, el consumo de extracto de cereza tiene un efecto significativo de reducción del dolor (WMD = -6,105 mm; IC del 95%: -11,193 -1,017; p = 0,019). Conclusión: El consumo de extracto de cereza fue eficaz para reducir el dolor muscular de aparición tardía entre los participantes en el análisis global y de subgrupos. Así, el extracto de cereza puede ser una alternativa complementaria en la recuperación después de los ejercicios. ***Nivel de evidencia II; Estudios terapéuticos - Revisión de manuscritos.***

***Descriptores*:** *Proteínas de Frutas; Lesiones de los Tejidos Blandos; Creatina Quinasa; Metaanálisis.*

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INTRODUCTION

Exercise-induced muscle damage (EIMD) may be happened after an intense exercise.[1] EIMD show itself via further symptoms. Elevated recognized soreness of DOMS can also multiply feeling of attempt, and decrease exercise strength. Sometimes, non-steroidal anti-inflammatory drugs (NSAIDs) are consumed by athletes. However, there are adverse effects related to the NSAIDs consumption. A nutritional supplementation to reduce EIMD, oxidative stress and inflammation might be enhanced by supplement that includes phytochemicals with both anti-inflammatory and antioxidant features. Tart cherries have been indicated on extend situation to be beneficial in recovery, which have high phytochemicals levels.[2,3] These combinations can decrease oxidative stress and been indicated to be cyclooxygenases (COX-1 and COX-2) inhibitor, as like as NSAIDs.

Mentioned outcomes show that tart cherry have antioxidant features post EIMD.[4,5] The exercise effect might need applying antioxidant like tart cherry supplement to inhibit EIMD and DOMS. Several papers have evaluated the tart cherry efficacy after exercise but these studies have provided conflicting outcomes. Therefore, the current review aims to study the tart cherry efficacy in ameliorating recovery after exercise.

METHODS

Strategy of Search

This meta-analysis carried out according to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). From inception to February 2022 a computerized search was done applying various databases consist of Scopus, ISI Web of Science, PubMed and a search in Google Scholar.

This study is only a review paper and does not involve any human participants for ethical declaration.

Criteria of Eligibility

Essays elected matching to the Population-Intervention-Comparator-Outcomes-Study design (PICOS),[1,2] including: The Population, Intervention, Comparison (adjusted control group), Outcome.

Inclusion criteria for including RCTs in the current meta-analysis were: 1) RCT original studies; 2) Subjects intake oral tart cherry; 3) reporting CK and VAS as EIMD marker and DOMS index; 4) record information as mean ± SD of CK and VAS. RCTs were excluded in the current review based on: 1) using combination of tart cherry in supplementation group only ;2) trials nonrandomized and without control groups; 3) animal studies; 4) duplicate papers with same subjects.

Strategy of Selection

After computerized search, all articles were exported into EndNote X6. According to search strategy titles papers were checked. Based on the inclusion criteria, two authors independently measured and elected studies. Eligibile papers were elected to be assessed by whole manuscript.

Quality of Studies

For evaluating the bias risk, Cochrane Collaboration items applied. The RCTs quality were evaluated by the following factors: generation of randomization sequence; concealment of allocation; participants and personnel blinding and rates of attrition. Based on the main items of allocation concealment, reporting of attrition rates and participants and assessor blinding a paper rated bias risk of high, low and medium (High = High bias risk for one or more main items, Low = Low bias risk for whole main items or Medium = Unclear and Low bias risk for whole main items).

Following formula were applied for studies with no mean change SD: change SD=square root [(SD after^2 + SD before^2) - (2×0.8×SD after SD before)]. Chi-squared ($\chi 2$) test applied for Heterogeneity of studies evaluation and calculated via I^2 statistic, that reports the total variation percentage among effect sizes.

For estimating the overall effect weighted mean difference (WMD) and 95 percent confidence interval (CI) computed applying model of random effects. subgroup analysis performed based on post exercise follow-ups, duration of supplementation, gender type and status of training. Moreover, for evaluating publication bias, tests of Begg's rank correlation and Egger's regression asymmetry applied.

NutriGrade

NutriGrade applies a rating system to determine the meta-analysis quality. NutriGrade provides these items: 1) bias risk, 2) precision, 3) heterogeneity, 4) directness, 5) publication bias, 6) funding bias and study design. For evidence validity assessment, NutriGrade provides 4 categories: 1) high; 2) moderate; 3) low and 4) very low.

RESULTS

Searching outcomes

Computerized search found 133 related articles. After remove of duplicate articles, a wide checking of papers was performed on 126 articles. Nineteen articles left after screening the eligibility of the inclusion and exclusion criteria. Finally, 11 articles included in meta-analysis, consist of 34 and 28 effect sizes for CK and VAS concentration, that assessed 191 and 206 subjects respectively. Subjects age were 19 to 37 years old

Table 1. Features of the included articles.

Author (y)	Article Design Features						Average age (y)	Sample Size		Muscle damage marker	Muscle soreness index
	design	country	training status	product names	duration (d)	gender		cherry	control		
Lamb et al. (2019)	RP	UK	T	CherryActive Ltd., Hanworth, UK	9	M	24	12	12	CK	VAS
Quinlan et al. (2019)	RP	UK	T	Holland and Barrett Ltd, 163 Warwickshire, England	8	M&F	26	10	10	CK	VAS
Brown et al. (2018)	RP	UK	T	CherryActive, Sunbury, UK	8	F	19	10	10	CK	VAS
Hillman et al. (2017)	RP	USA	U	Cheribundi, Geneva, NY, USA	10	M&F	23	8	8	CK	VAS
Bell et al. (2016)	RP	UK	T	CherryActive, Sunbury, UK	7	M	25	8	8	CK	VAS
Bell et al. (2015)	RP	UK	T	CherryActive, Sunbury, UK	8	M	30	8	8	CK	VAS
Levers et al. (2015)	RP	USA	T	CherryPURE™ Shoreline Fruit, LLC, USA	7	M	21	11	12	CK	VAS
Bell et al. (2014)	RP	UK	T	Cherry Active, Hanworth, UK	7	M	30	8	8	CK	-
Bowtell et al. (2010)	CP	UK	T	CherryActive® , CA	10	M	27.8	10	10	CK	-
Howatson et al. (2010)	RP	UK	T	Cherrypharm Inc., Geneva, New York, USA	1	M	37	10	10	CK	VAS
Kuehl et al. (2010)	RP	USA	T	Cherrish Inc., Seattle, WA, USA	1	M & F	35.8	26	25	-	VAS

CK = Creatine kinase; VAS = Visual analogue scale; RP = randomized controlled trial; CP = cross-over studies; M = male; F = Female; D=Days; Y=years; T=trained; U= untrained.

and in 5 studies participants were men,[1-6] in 4 studies both men and women participated[7-10] and in a study that only females took part.[11] Table 1 presented reasons for studies exclusion and selection process.

Results of quality assessments

seven studies reported the random sequence generation method.[1,3,4,7,8,10,11] Five studies reported allocation concealment.[1,4,9-11] All studies reported low bias risk according to incomplete outcome. Also, all articles had high and unclear bias risk except four articles that reported low risk about of participants and personnel blinding and assessment of outcome.[1,4,10,11] At last, most of articles had medium bias risk, four studies had low bias risk[1,4,10,11] and two articles had high bias risk.[2,5]

Findings from tart cherry supplementation effects on muscle damage marker

Tart cherry supplementation effects on CK levels

Tart cherry administration had no significant decreasing effect on CK levels overally. Considerable heterogeneity observed amongst the articles. (Figure 1) For evaluating if the effect of tart cherry administration on CK levels is contradictory, meta-analysis performed by follow-up times measurements post exercise, supplementation duration gender type and status of training. (Table 2). Subgroup analyses indicated that

Table 2. Tart Cherry Effect on CK levels and VAS index in Subgroup Analysis.

Subgroups	No. of trials	Effect size[1]	95% CI		P Value	I^2 (%)	p for heterogeneity
CK							
Duration							
acute (single dose)	3	17.571	-31.505	66.647	0.483	0.0	0.956
>1 day	31	-348.753	-744.967	-0.461	0.044	97.0	<0.001
Gender							
Male	20	74.401	-12.890	135.912	0.118	97.9	<0.001
Female	4	-67.821	-152.851	-17.210	0.017	22.4	0.276
Male & Female	10	-58.305	-100.655	15.955	0.118	0.0	0.781
Train status							
trained	30	23.152	-30.009	76.313	0.393	97.0	<0.001
untrained	4	-40.320	-88.706	-8.066	0.042	0.0	0.957
VAS							
Duration							
acute (single dose)	4	-4.139	-21.418	13.140	0.639	79.2	0.028
>1 day	24	-6.268	-11.608	-0.929	0.021	87.8	0.325
Gender							
Male	13	-3.534	-10.611	3.543	0.328	92.3	<0.001
Female	4	-6.105	-11.193	-1.017	0.001	0.0	0.638
Male & Female	11	-8.422	-15.145	1.698	0.114	47.4	0.040
Train status							
trained	24	-5.427	-10.865	0.011	0.051	88.9	<0.001
untrained	4	-11.449	-21.468	-1.429	0.025	0.0	0.960

[1]Calculated by random effects model. CI = confidence interval.

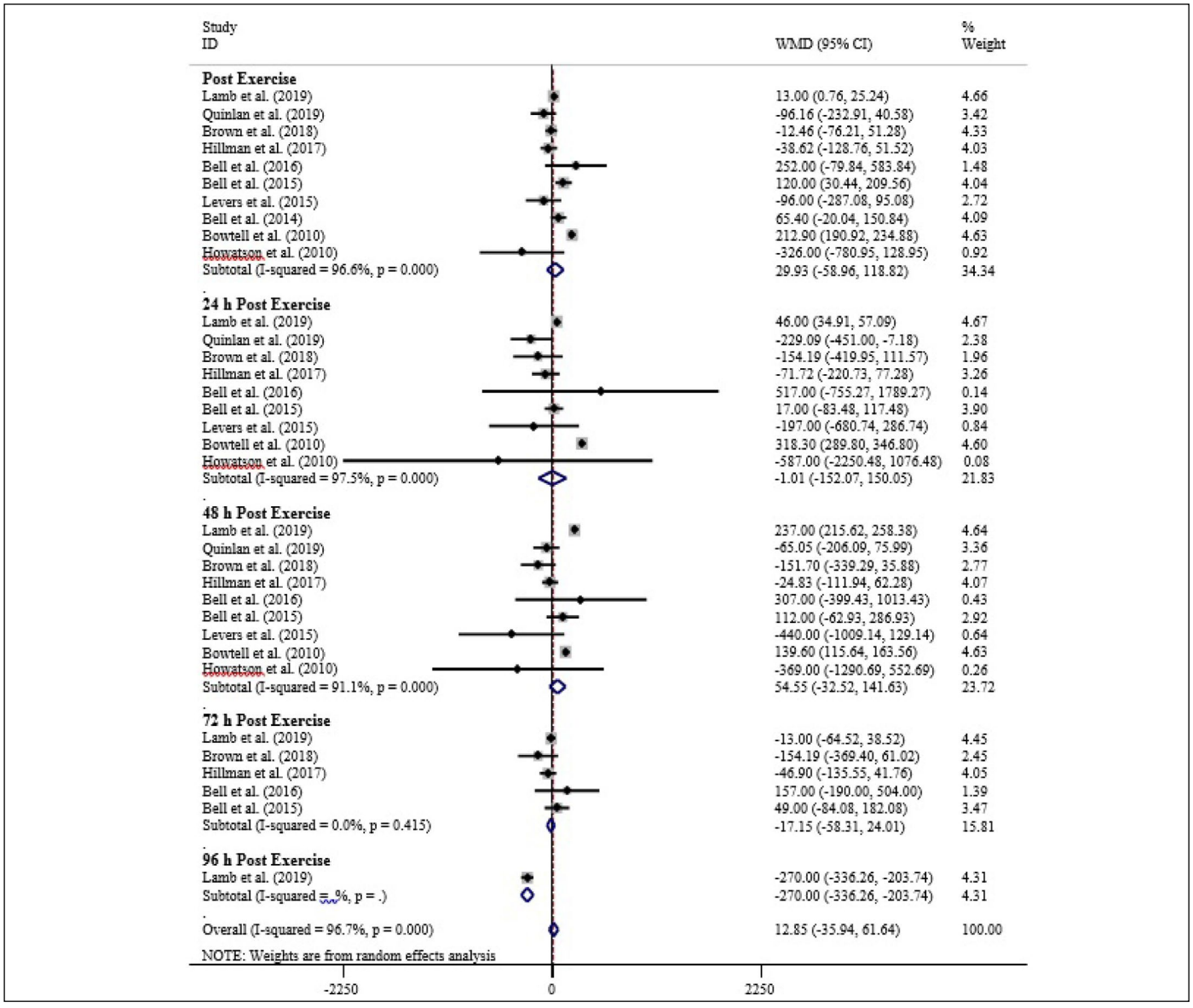

Figure 1. Tart cherry effect on CK levels.

cherry administration have a significant decreasing effect on CK levels in trials with more than 1-day cherry administration, trials with female participant and trials on participant with trained status.

Tart cherry supplementation effects on VAS index

Tart cherry administration impact on VAS index indicated a significant decreasing effect on VAS index in pooled mean (Figure 2). Also considerable heterogeneity observed amongst the articles**.** Meta-analysis performed according to follow-up times measurements post exercise, supplementation duration, gender type and status of training. (Table 2). Some of subgroup analyses indicated that cherry administration have a significant decreasing effect on VAS index in trials with more than 1-day cherry administration.

DISCUSSION

The results of the present review showed useful effects of cherry administration in decreasing DOMS but not EIMD during different periods of training protocols.

DOMS is categorized as a muscle strain that appears with stiffness 24 hours and peaks within 48 hours after unaccustomed exercise.[12] up to now a certain treatment for EIMD and DOMS has not been fixed and the EIMD progress is not totally found out, but it has been explained as a two section mechanisms. The first section is structural disruption to sarcomeres. The secondary section is featured by intracellular Ca^{2+} elevation. Until now, tart cherry showed strength potential for improving recovery from EIMD arguably.

There were no significant differences in CK concentrations between intervention and placebo groups (Figure 1). CK concentrations appeared to augment considerably at 72 hours after exercise, and were at their highest at the 96 hours. It seems that with the increase of muscle damage caused by exercise, the decreasing effect of tart cherry on CK concentrations can be more beneficial.[8]

Supplementation with cherry lead to reductions in DOMS index based on the overall analysis. Due to this pathogenesis, antioxidants lead to alleviating muscles pain created by damaging exercise.

Cherry consumption more than a day lowered CK concentrations and VAS index. Nonetheless, single dose had no considerable impact on CK levels and VAS index. About 40 tart cherries consumption a day has been indicated to decrease inflammation factors in healthful adults. In addition, by CRP evaluated in male and female youth.

Moreover, women have been proven to indicate less CK concentrations, and less response of CK following physical activity compared to men.[12]

We acknowledge that in several included studies, DOMS may have a more complicated cause and other etiology of post exercise muscle soreness may have related to the outcome scores reported. So, caution should be taken when interpreting these outcomes.

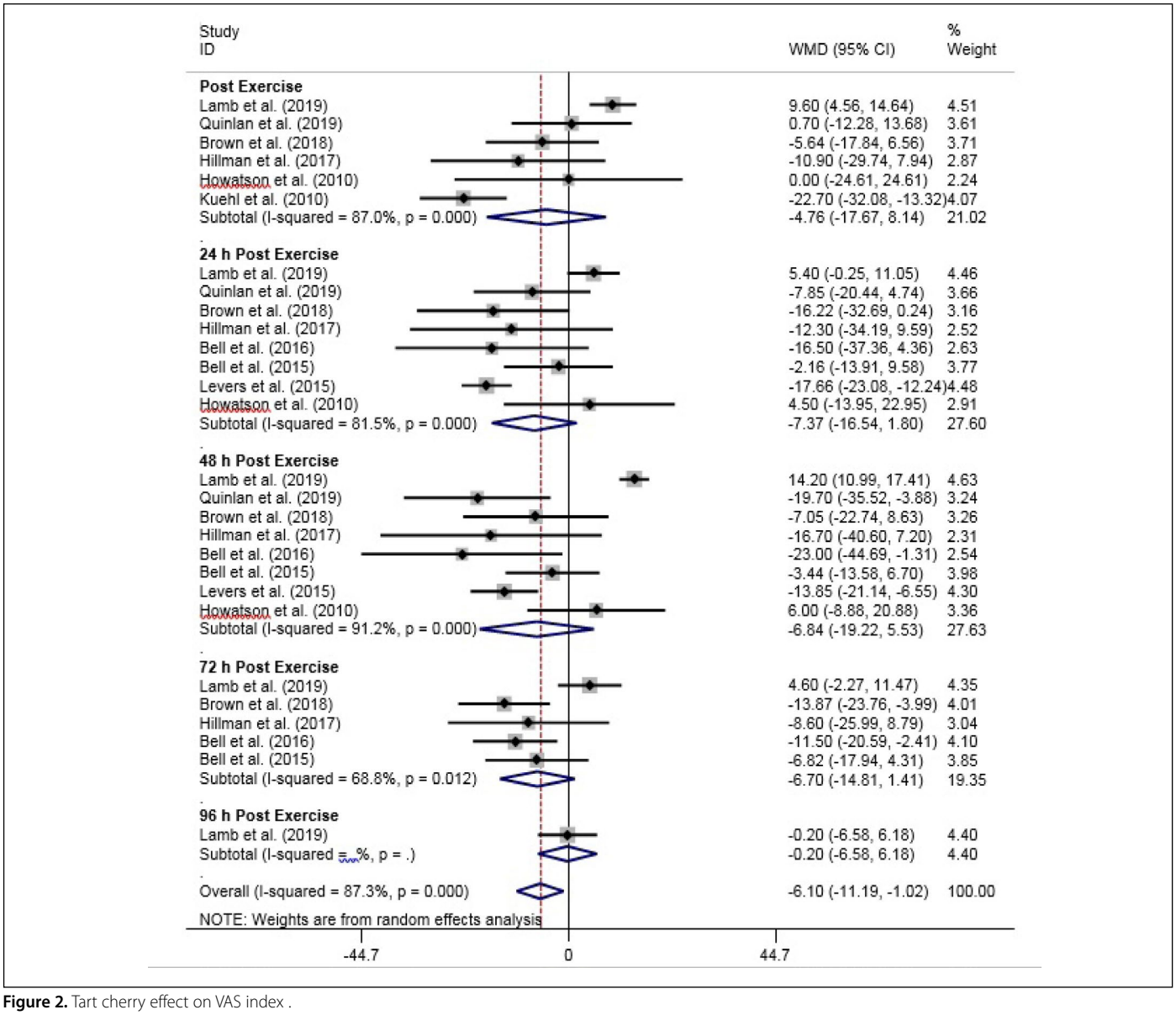

Figure 2. Tart cherry effect on VAS index .

CONCLUSION

In brief, tart cherries considering high anti-inflammatory properties, are beneficial for those with muscle soreness. Current meta-analysis indicates that the tart cherry consumption for one week decreased symptoms of EIMD and DOMS among healthy adults taking part in a severe endurance event. More studies on this field is needed in order to clarify the potential mechanism for the decrease in soreness and inflammation relates with tart cherry supplementation.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: The work is conceived and knowledge content by Haishan Liu, methodology by Mingjiang Zhu, and execution done by Yuanjing Li, Investigation and formal analysis is by Siti Chengyun Zhang, project administration and resources is by Yejun Bie, supervision, validation and manuscript drafting is completed by Hui Zhang. All authors contributed equally in execution and writing of this manuscript.

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