



POSITIVE MENTAL HEALTH AND MEAT CONSUMPTION: A SYSTEMATIC AND META-ANALYTIC REVIEW

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Abstract

In this systematic and meta-analytic review, we examined the current evidence on positive psychological variables between individuals who consumed meat and individuals who abstained from meat consumption. After systematically searching five online databases for primary research on positive psychological outcomes in meat consumers and meat abstainers, 19 studies with 94,204 participants ($n_{meat\ consumers} = 82,449$, $n_{meat\ abstainers} = 9,964$) met the inclusion/exclusion criteria. The primary outcomes were self-esteem, satisfaction with life, and positive mental health. The secondary outcomes were positive affect, psychological well-being, vigor, optimism, happiness, and meaning in life. Individuals who consumed meat had greater positive mental health ($g = 0.21$, 95% CI [0.08, 0.31], $p = .001$) than meat abstainers. No significant differences were found between the groups on self-esteem ($g = 0.19$, 95% CI [-0.01, 0.38], $p = .06$) and satisfaction with life ($g = 0.02$, 95% CI [-0.04, 0.07], $p = .57$). The majority of studies examining the secondary outcomes showed no group differences. The evidence was limited, requiring more studies to determine the role of study quality in diet-*health* relations. Study designs precluded inference of causal and temporal relations. With respect to clinical practice, our findings add to the current controversial diet-health debate.

Keywords

Meat, Vegan, Vegetarianism, Positive Mental Health, Self-Esteem, Life Satisfaction

Introduction

The relations between dietary patterns and mental health are well-established, showing that restrictive diets (i.e., vegetarianism, veganism) are associated with a greater risk of depression and anxiety (Branca et al., 2019; Dobersek & Archer, 2022; Dobersek et al., 2021; Dobersek, Wy, et al., 2020; O'Neil et al., 2015; Olatona et al., 2018; Stein et al., 2019). One explanatory mechanism for this evidence is that people who refrain from eating meat or other animal products experience dietary deficiencies, which consequently lead to poorer mental health (Cofnas, 2019; Dwyer, 1991). In fact, meat and animal-based products are among the most nutritious food items available to humans because of their high caloric density and essential nutritional components (vitamins, amino acids, minerals, bioactive compounds), which are vital for the development and maintenance of psychological health (Beal & Ortenzi, 2022; Głąbska et al., 2021; Herbison et al., 2012; Mahdavifar et al., 2021; Mann, 2000).

However, although animal foods provide essential nutrients (e.g., ω -3 fatty acids, creatine, calcium, iron, carnitine, zinc, vitamins A, B₆, B₁₂, and K) (Beal & Ortenzi, 2022; Mann, 2000), the prevalence of vegetarian diets and vegan lifestyles worldwide has increased over the past few decades. Individuals refrain from meat and/or other animal-related products for a number of reasons, including animal rights, environmental, and ethical reasons, as well as attempts to ameliorate and treat psychological disorders via dietary intake restrictions (Kerschke-Risch, 2015; Kerschke-Risch, 2016; Rosenfeld, 2019; Whorton, 1994). Consequently, the claim of whether avoidance or

consumption of meat is linked to greater psychological health became a contentious topic in nutrition research (Jacka et al., 2012; Mofrad et al., 2021; Zeraatkar et al., 2019).

Most research on diet-health relations has been studied from a *disease*-related perspective, focusing on negative psychological functioning. This is not surprising given the increased prevalence of mental disorders in the past century. Although diet-*disease* ideology offers insights into associations between poor mental health and dietary patterns, it does not equip science to effectively treat and prevent pathologies or provide clinicians with insights into the origin, maintenance, and promotion of one's health. Therefore, recently researchers have been identifying 'salutogenic' factors (e.g., diet, exercise) that may inform methods to achieve health beyond what is known from examining the risk factors that exacerbate pathologies (Kubzansky et al., 2015; Seligman & Csikszentmihalyi, 2000). Specifically, previous research examined diet quality and 'healthy' eating in relation to several positive psychological variables, including life satisfaction, optimism, quality of life, self-efficacy, and resilience (Govindaraju et al., 2018; Hingle et al., 2014; Muros et al., 2017; Serlachius et al., 2015; Vajdi & Farhangi, 2020; Whatnall et al., 2019; Wu et al., 2017).

Nevertheless, the existing reviews have several limitations that we attempted to remedy in our previous scoping review in which we qualitatively summarized the existing literature on the association between the consumption of meat and positive psychological functioning (Dobersek et al., 2024). However, to date, no quantitative synthesis has been performed on diet-*health* relations. Therefore, to close the gap in the scientific literature, in this review, we 1) comprehensively assessed the quantitative associations between the consumption or avoidance of meat and the most commonly studied positive psychological outcomes in the extant literature (i.e., self-esteem, life satisfaction, and positive mental health), and 2) attempted to analyze the effect of methodological rigor on these relations.

Method

Search Strategy

We used a predetermined set of key terms to search for original peer-reviewed articles on positive psychological outcomes in meat abstainers and meat consumers in PubMed, PsycINFO, CINAHL Plus, Cochrane Library, and Web of Science. Also, using a snowball procedure, we examined references from relevant research papers and reviews. The search was conducted by four authors (UD, MB, AE, GFG) and included all papers published through January 2023. Please see *Supplemental File 1* for a detailed description of the search process.

We imported the searches into EndNote software (EndNote20, 2022) and after excluding the duplicates, papers were imported into Rayyan, a free web application that facilitated the initial screening of the articles (Ouzzani et al., 2016). Three authors (MB, AE, GFG) then independently screened titles and abstracts. Full texts of possibly applicable papers were examined by co-authors (UD, MB, AE, GFG) working independently. Afterward, the investigators met to reach an agreement on each paper's inclusion/exclusion criteria. We resolved disputes via discussion, and agreement was achieved for all articles included in the review.

Study Inclusion & Exclusion Criteria

We included studies if 1) the authors examined positive psychological outcomes (e.g., happiness, optimism, self-esteem, satisfaction with life, positive mental health), 2) there was a clear difference between meat consumers and meat abstainers (i.e., vegans, vegetarians), 3) they provided statistical information for calculation of the effect sizes (ESs), or we were able to obtain it from the authors, and 4) they were written in the English language.

We excluded studies if they 1) examined outcomes unrelated to positive psychology (e.g., depression, anxiety, physical health), 2) combined psychological outcomes with physical health, 3) omitted (or could not obtain) statistical information to calculate ESs, 4) included meat consumption as a continuous or multi-level variable, and 5) were written in a language other than English. Table 3 in *Supplement File 1* below describes inclusion/exclusion criteria using a Population, Exposure/Intervention/Comparison, Outcomes, and Study Design (PEI/COS) framework (Brown et al., 2006; Huang et al., 2006).

We divided the qualified outcomes into two categories—primary and secondary, according to how often they were studied in the current literature. Due to the lower frequency of the secondary outcomes, we only performed a meta-analysis on the primary studies.

Data Extraction

The investigators (MB, AE, GFG) performed data extraction independently, which was overseen by the lead author. From each study, we extracted information on design, recruitment strategies, participant characteristics, assessment methods for positive psychological outcomes and diet, meat consumers and meat abstainers definitions, confounding variables, main findings, and pertinent data for calculating the ESs (e.g., *Ms*, *SDs*, *SEs*, *p*-values). Each author double-checked the extraction information, and UD examined them for completeness and accuracy. Table 1 includes details on data extraction.

Short Citation	Country	Design	Population	Recruitment Methods	Dietary Assessment	Positive Psychological Variables	Factors Adjusted in Analyses	Key Findings	Measure of association & risk of bias
Aslanifar et al. (2014)	Iran	Cross-sectional	300 adults 132 males & 168 females between 20 & 60 years	Cluster (vegetarians) & convenience (nonvegetarians)	Nonvegetarians = 150 Vegetarians = 150	The Oxford Happiness Questionnaire (OHQ) to assess happiness: a 29-item measure. Higher scores denote higher levels of happiness	Groups were matched on age & education level	Vegetarians scored significantly higher than nonvegetarians on happiness.	SR only
Baines et al. (2007)	Australia	Cross-sectional	9,113 women 22 & 27 years of age	Random selection from the national health insurance database (Medicare)	Do you exclude any of the following food groups from your diet? Vegetarians (excluded meat, poultry, & fish) = 252 Semi-vegetarians (excluded red meat) = 827 Nonvegetarians (included red meat) = 8034	The Short Form Health Survey (SF-36): summary scores for mental health (score > 50 better health than the reference population; score < 50 worse health than the reference population)	Oversampling of women from rural & remote areas	Nonvegetarians had significantly better mental health than vegetarians & semi-vegetarians.	<i>M, p-value</i>
Bas et al. (2005)	Turkey	Cross-sectional	1,205 students 597 females & 608 males 17 & 21 years old ($M_{age} = 21.3, SD = 1.9$)	Multistage cluster sampling method	Are you a vegetarian? Yes/No Vegetarians = 31 Nonvegetarians = 1174	The RSES assesses general self-esteem: a 10-item measure that uses a 4-point Likert-type scale from 0 (<i>strongly agree</i>) to 3 (<i>strongly disagree</i>)	NR	NS between vegetarians & nonvegetarians on self-esteem.	<i>M, SD</i>
Beezhold et al. (2010)	USA	Cross-sectional	138 Seventh Day Adventists 77 females & 61 males ($M_{age} = 43.04$)	Volunteers from Seventh Day Adventist communities in Phoenix, AZ & Santa Barbara, CA	The FFQ with 152 items Omnivores = 78 Vegetarians (excluded all flesh foods) = 60	The POMS-V estimates vigor using 8 adjectives rated on a 5-point Likert-type scale ranging from 'not at all' to 'extremely'	Confounding variables	NS between the groups on vigor.	SR only

Beezhold et al. (2012)	USA	RCT	39 adults 32 females & 7 males	NR	Participants were randomized to omnivore group (consumed meat and/or poultry at least once daily) = 13, fish group (avoided meat, poultry, & consumed at least 3-4 servings of seafood weekly) = 13, or vegetarian group (avoided all animal foods except dairy for 2 weeks) = 13	The POMS: a widely used mood scale; we used a vigor subscale (POMS-V)	NR	NS between the groups after the trial on vigor.	SR only
Boldt et al. (2018)	Europe	Cross-sectional	281 endurance runners 159 females & 122 males ($M_{age} = 40, SD = 11$)	Social media, websites of marathon events, online running communities, email lists, magazines for runners, health, vegetarian and/or vegan nutrition & lifestyle, sports fairs, fairs on vegetarian & and vegan nutrition & lifestyle, & personal contacts	Omnivores (no dietary restrictions) = 123 Vegetarian/vegan (no meat, no products from animal sources, such as meat, fish, milk, dairy products, eggs, honey) = 158	The WHOQOL-BREF: 26 items measuring 4 broad domains: 1) physical health, 2) psychological well-being, 3) social relationships, 4) environment on a 5-point Likert-type scale; higher scores denote higher QoL	NR	NS between the groups on psychological well-being.	SR only
Kaluza et al. (2023)	Poland	Cross-sectional	636 females ($M_{age} = 23.9, SD = 5.7$)	Social media platforms	Omnivores (no dietary restrictions) = 301 Vegetarians (no meat) = 211 Vegans (no meat and other products from animal sources) = 124	WHO-5 Index: 5 items measuring subjective well-being on a 6-point Likert-type scale ranging from 0 (<i>at no time at all</i>) to 5 (<i>all of the time</i>); higher scores denote higher well-being	Age, place of residence, education, marital status, physical activity, BMI, self-reported health status, cigarette smoking, sleeping time, experience a traumatic event, stress levels, Mediterranean diet score	Vegans had higher subjective well-being scores than omnivores and vegetarians.	SR only

<p>Kessler et al. (2018)</p>	<p>Germany</p>	<p>Cross-sectional</p>	<p>197 adults 45 males, 152 females</p>	<p>The VegMed 2013 conference on plant-based nutrition for medical professionals in Berlin, Germany</p>	<p>Self-report questionnaire about eating habits (i.e., consumption of meat, fish, eggs, and/or dairy products) Omnivores = 55 Vegetarians = 78 Vegans = 64</p>	<p>WHOQOL-BREF</p>	<p>Bonferroni correction</p>	<p>NS among omnivores, vegetarians, and vegans on psychological well-being.</p>	<p>SR only</p>
<p>Krizanova & Guardiola (2021)</p>	<p>Spain</p>	<p>Cross-sectional</p>	<p>1068 university students 406 males & 662 females between 18 & 54 years ($M_{age} = 20.7, SD = 2.85$)</p>	<p>Convenience sampling</p>	<p>"Please select the option that best describes your diet:" Vegan (ate fruits, vegetables legumes, cereals, do not eat red or white meats, dairy, eggs, seafood, fish) = 11 Lacto-ovo vegetarian (ate eggs, dairy products, do not eat fish, seafood, white or red meat) = 43 Lacto-pesco vegetarian (ate dairy, fish, seafood, do not eat meat) = 32 Flexitarian (did not eat meat at least once a week) = 139 Organic omnivores (ate organic meat) = 21 Omnivore (ate meat, fish, seafood, fruit, vegetables, cereals) = 822</p>	<p>Life satisfaction: a single item ("How satisfied are you at this moment with your life?") on a 10-point Likert-type scale from 1 (<i>completely dissatisfied</i>) to 10 (<i>completely satisfied</i>) Subjective vitality: the conscious experiences of possessing energy and vivacity that reflects the eudaimonic dimension of well-being; measured using 6 statements (e.g., "I feel alive and vital.") on a 5-point Likert-type scale from 1 (<i>totally false</i>) to 5 (<i>extremely true</i>)</p>	<p>Parents' income, gender, relationship status, connection with relatives</p>	<p>NS differences among the groups on life satisfaction & vitality.</p>	<p><i>M, SD</i></p>

Lavallee et al. (2019)	Germany, USA, Russia, China	Cross-sectional	22,417 adults		*"Are you currently vegetarian?" Yes/No	The Positive Mental Health (PMH) scale is a 9-item questionnaire that was developed for the purpose of the study and assessed positive aspects of health and life experiences (e.g., "I am often free and in good spirits", "I enjoy my life").		Cross-sectional: Vegetarians (Russian sample) had lower PMH than nonvegetarians.	M, SD
		Longitudinal	**13,006 females & 8,596 males (M _{age} = 39.10, SD = 11.68)	Data drawn from Bochum Optimism and Mental Health (BOOM) studies; representative individuals from respective countries recruited via telephone	Vegetarians (excluded meat and/or fish) = 3,400	Items are answered on a 4-point Likert-type scale ranging from 0 (do not agree) to 3 (agree)	Age, gender, urbanicity, marital status, educational level, socioeconomic status, family influence	Longitudinal:	were calculated from the data available online – re-analyzed the data to check it is consistent with the results reported in the article; post findings only for German & Chinese
Lindeman (2002)	Finland	Cross-sectional	<u>Study 1:</u> 308 women between 13 & 74 years (M _{age} = 29, SD = 10.81)	Convenience sampling	<u>Study 1:</u> Omnivores = 197	<u>Study 1:</u> The RSES assesses general self-esteem: a 10-item measure that uses a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree);	NR	<u>Study 1:</u> Omnivores had greater self-esteem levels than vegans & semi-vegetarians.	M, SD
			<u>Study 2:</u> 226 women between 16 & 54 years (M _{age} = 22.3, SD = 8.68)		Semi-vegetarians (avoided red meat or only ate fish, vegetarian dishes) = 69	the higher the score, the higher the self-esteem.		<u>Study 2:</u> Omnivores & semi-vegetarians had greater self-	
					Vegetarians = 42	<u>Study 2:</u> The Self-Worth subscale of the World Assumption Scale measured worthiness of the self with 4 items; uses a 5-point			

Nezlek et al. (2018)	USA	Cross-sectional	Convenience sampling	<p>-</p> <p>*Omnivores = 148</p> <p>Semi-vegetarians = 60</p> <p>Vegetarians = 17</p>	<p>Likert-type scale from 1 (<i>strongly disagree</i>) to 5 (<i>strongly agree</i>); the higher the score, the higher the belief in self-worth.</p>				worth than vegetarians.		
				<p>403 university students</p>	<p>"Which of the following seven categories best characterize your eating behavior?"</p>	<p>Adopted from the RSES that assesses general self-esteem: a 4-item measure on a 7-point Likert-type scale from 1 (<i>very uncharacteristic of me today</i>) to 7 (<i>very characteristic of me today</i>) (e.g., "Today, on the whole, I was satisfied with myself.");</p>				<p>Omnivores & semi-vegetarians (together) had greater self-esteem & meaning in life than vegetarians.</p>	<p><i>M, SE</i></p>
				<p>153 males & 250 females (<i>M</i>_{age} = 18.8, <i>SD</i> = 11.4)</p>	<p>Vegetarians (ate fruits, vegetables, grains, dairy, eggs, seafood products) = 24</p>	<p>Life satisfaction: 2 items ("How was today?", "How satisfied were you with your life today?") on a 7-point Likert-type scale from 1 (<i>terrible/very dissatisfied</i>) to 7 (<i>excellent/very satisfied</i>);</p>					<p>Transferred <i>SE</i> into <i>SD</i> data were provided by the first author.</p>
				<p>Semi-vegetarians (ate fish, white meat, red meat occasionally) = 56</p>	<p>Omnivores = 323</p>	<p>Meaning in life: 2 items ("How meaningful did you feel your life was today?", "How much did you feel your life had purpose today?") on a 7-point Likert-type scale from 1 (<i>not at all</i>) to 7 (<i>very much</i>);</p> <p>Positive activated emotions (enthusiastic, alert, happy, proud, excited) and</p> <p>Positive deactivated emotions (calm, peaceful, relaxed, contented, satisfied); how strongly participants felt each day on a 7-point scale from 1 (<i>did not feel this way at all</i>) to 7 (<i>felt this way very strongly</i>)</p>	Sex			<p>NS differences between the groups on life satisfaction, positive activated, & deactivated emotions.</p>	

Norwood et al. (2019)	Australia	Cross-sectional	393 adults 67 males & 326 females between 17 & 70 years (<i>M_{age}</i> = 29.38, <i>SD</i> = 13.12)	Research participation pools, online advertisement on forums, social media, community webpages, word of mouth	Participants self-categorized to Vegetarian = 48 Vegan = 128 Unrestricted diet = 101 Paleo = 42 Gluten-free = 38 Weight-loss = 36	Self-Esteem: a single item, "I have high self-esteem," rated on a scale ranging from 1 (<i>not very true of me</i>) to 5 (<i>very true of me</i>).	Bonferroni correction	NS difference between vegans or vegetarians & individuals with unrestricted diet.	<i>M, SD</i>
Pfeiler & Egloff (2018)	Germany	Cross-sectional	<u>Study 1:</u> 4496 adults	<u>Study 1:</u> The German Socio-Economic Panel (SOEP) of the German Institute for Economic Research, a large longitudinal representative survey	<u>Study 1:</u> "Are you vegetarian or vegan?" Yes/No	<u>Study 1 & 2:</u> Current life satisfaction: a single item ("How satisfied are you with your life, all things considered?") on a scale from 0 (<i>completely dissatisfied</i>) to 10 (<i>completely satisfied</i>)	Sociodemographic variables (age, gender, education, income)	<u>Study 1:</u> NS differences between vegetarians & omnivores on life satisfaction & optimistic attitude.	<i>M, SD</i>
			2351 females & 2145 males between 17-96 (<i>M_{age}</i> = 51.84, <i>SD</i> = 18.36)	<u>Study 2:</u> The Innovation Sample of the SOEP - representative sampling from German population	Vegetarians/vegans (do not eat meat & avoid fish; avoid any animal products) = 123 Omnivores (consumed meat) = 4,373	Optimist attitude: a single item ("When you think about the future, are you....") on a 4-point scale from 1 (<i>pessimistic</i>) to 4 (<i>optimistic</i>)		<u>Study 2:</u> NS differences between the groups on life satisfaction & optimism after controlling for socio-demographic variables.	
			<u>Study 2:</u> 5125 adults		<u>Study 2:</u> "Do you predominantly or exclusively follow a vegetarian or vegan diet?" Yes/No Vegetarians = 278				

									**2669 females & 2409 males ($M_{age} = 52.42$, $SD = 18.34$)	Vegans = 28 Meat eaters = 4819
	<u>Study 1:</u>	<u>Study 1 & 2:</u>	<u>Study 1:</u>	<u>Study 1:</u>	<u>Study 1:</u>	<u>Study 1:</u>	Sociodemographic variables	<u>Study 1 & 2:</u>	<u>Study 1:</u>	
Germany	Cross-sectional	12,905 individuals 6918 females & 5987 males between 21 & 102 years ($M_{age} = 56.21$, $SD = 16.69$)	German Socio-Economic Panel of the German Institute for Economic Research, a representative sample from private households & persons	"Do you follow a mainly vegetarian or vegan diet?" Yes/No/None of the above	Positive affect: a single item (happy) "Please indicate for each feeling how often or rarely you experienced this feeling in the last four weeks?" on a 5-point Likert-type scale from 1 (<i>very rarely</i>) to 5 (<i>very often</i>)	(sex, age, education)	NS differences between vegetarians & meat eaters on positive affect & life satisfaction after controlling for socio-demographic variables.		<u>Study 1:</u>	<i>n</i> & <i>p</i> -values
Pfeiler & Egloff (2020)	<u>Study 2:</u>	15,532 individuals 7302 males & 8230 females between 15 & 99 years ($M_{age} = 45.44$, $SD = 18.95$)	Household, Income, and Labour Dynamics in Australia survey, a large, longitudinal, household-based study	Vegan = 72	Life satisfaction: a single item ("How satisfied are you with your life, all things considering?") on an 11-point Likert-type scale from 0 (<i>completely dissatisfied</i>) to 10 (<i>completely satisfied</i>)				<u>Study 2:</u>	
Australia				Meat eaters = 12,240	Positive affect: 4 items ("How much of the time during the past 4 weeks have you been a happy person, have you felt calm and peaceful, did you feel full of life, did you have a lot of energy?") on a 6-point Likert-type scale from 1 (<i>none of the time</i>) to 6 (<i>all of the time</i>); Life satisfaction: single item ("How satisfied are you with your life?") on an 11-point Likert-type scale from 0 (<i>completely dissatisfied</i>) to 10 (<i>completely satisfied</i>)				<u>Study 2:</u>	<i>M</i> , <i>SD</i>

					"How often do you usually eat each of the following types?" Vegetarians (never consumed beef, veal, lamb, pork, dishes with major component of meat) = 383 Meat eaters (consumed at least some meat or fish) = 15,149				
Quick & Byrd-Bredbenner (2013)	USA	Cross-sectional	2,286 college students 1,440 females & 846 males	Convenience sampling from three public U.S. universities	Nonvegetarians/nonvegans = 2,099 Vegetarians/vegans = 187	The RSES assesses self-confidence on a 5-point Likert-type scale ranging from 1 to 5; the higher scores indicate lower self-esteem	Race/ethnicity, BMI, gender	Vegetarians/vegans had lower self-esteem compared to nonvegetarians/nonvegans.	<i>M, SD</i> The poster was provided by the authors
Shreiner et al. (2019)	Switzerland	Cross-sectional	1254 adult patients 658 females & 596 males between 25 & 75 years (<i>Median age = 28.85</i>)	Data drawn from the SIBDC Study – a nationwide cohort enrolling IBD patients in Switzerland	"How many times a week do you eat meat?" If never, they were vegetarians = 52 Nonvegetarians = 1,202	The SF-36: summary mental health; a higher score indicates better mental health	NR	Nonvegetarians had better mental health than vegetarians.	<i>n, p-values</i>
Timko et al. (2012)	USA	Cross-sectional	486 university students **374 females & 111 males between 18 & 40+ years of age (<i>M_{age} = 24.90, SD = 9.54</i>)	Psychology department research pools from two universities, flyers distributed to local health food stores, & via internet (general psychology study sites, pages devoted to vegetarianism)	Self-report of vegetarian status and the FFQ by Osler and Heitmann (1996) Vegans (excluded all animal products) = 35 Vegetarians (ovo-, lacto- or lacto-ovo vegetarian) = 111 Semi-vegetarians (consumed no red meat or pork, but occasionally consumed fish or poultry) = 75 Omnivores (ate all foods including all meat & other animal products) = 265	The RSES assesses general self-esteem: a 10-item measure that uses a 4-point Likert-type scale from 0 (<i>strongly agree</i>) to 3 (<i>strongly disagree</i>)	NR	NS differences among the groups on self-esteem.	<i>M, SD</i>

Velten et al. (2018)	Germany	Cross-sectional	15,396 university students from Germany (2,991) and China (12,405);	"Do you currently follow a vegetarian diet?" Yes/No				<i>Cross-sectional:</i>	<i>M, SD</i>
	China	Longitudinal	**9,441 females & 5,956 males between 15-65 years ($M_{age} = 21.14, SD = 2.83$)	Vegetarian (no meat, fish) = 3,216				German sample - Vegetarian diet was associated with lower PMH.	were calculated from the data provided by the first author based on the German sample only
			Part of the BOOM studies & invitation via email	Nonvegetarian = 12,180	The PMH Scale measures eudaimonic & hedonic well-being. It consists of 9 non-specific judgments (e.g., "I feel that I am actually well equipped to heal with life and its difficulties.") on a 4-point Likert-type scale from 0 (<i>do not agree</i>) to 3 (<i>agree</i>)	Chinese students matched for gender & age	Chinese sample – NS differences between the groups. Matched sample - vegetarian diet was associated with lower PMH.		
							Chinese sample – NS differences between the groups. Matched sample – NS differences between the groups.		

*Discrepancies between the total sample of participants and the diet groups

**Discrepancies between the total sample of participants and the number of males/females

Note: BMI = body mass index; BOOM = Bochum Optimism and Mental Health; FFQ = Food Frequency Questionnaire; IBD = Inflammatory Bowel Disease; M = mean; M_{age} = mean age; n = sample size; NS = not statistically significant; NR = not reported; OHQ = Oxford Happiness Questionnaire; RCT = Randomized Control Trial; The RSES = The Rosenberg Self-Esteem Scale; SD = standard deviation; SF = short form; SIBDC = Swiss Inflammatory Bowel Disease Cohort; SE = standard error; SOEP = Socio-Economic Panel of the German Institute for Economic Research; SR = studies only included in the systematic review; The POMS-V = The Profile of Mood States-Vigor; The PMH = The Positive Mental Health; p -value = probability value; WHO = World Health Organization; The WHOQOLA-BREF = The World Health Organization Quality of Life Assessment

Methodologic Quality Assessment

Two authors (UD, LSR) independently examined each study included in the review for methodologic quality using a 100-point scale adopted from our previous reviews (Dobersek et al., 2021; Dobersek, Wy, et al., 2020). Studies were evaluated for recruitment procedures, design, statistical analyses, results, and communication of findings. Please see *Supplemental File 2: Assessment of Study Quality* for more details.

The Statistical Method of Estimation of Effect Sizes and Analyses

We calculated standardized mean differences (d family) between meat consumers and meat abstainers on primary outcomes of self-esteem, life satisfaction, and positive mental health using Borenstein and colleagues' statistical techniques (Borenstein et al., 2011; Borenstein et al., 2005). Specifically, for study i we computed

$d_i = \frac{(\bar{Y}_i^A - \bar{Y}_i^M)}{S_i^p}$, where \bar{Y}_i^A is the mean score on self-esteem, life satisfaction, or positive mental health for meat consumers, \bar{Y}_i^M is the corresponding average for meat abstainers and S_i^p is the weighted pooled SD across the two groups. Given that variables have positive valences, higher scores suggest more positive outcomes. As such, positive d_i values suggest better outcomes for individuals who consume meat and poorer outcomes for individuals who abstain from meat. Equally, negative d_i values suggest favorable outcomes (higher scores) for individuals who abstain from meat. If Ms and SDs were unavailable, we used SEs and p -values and transformed the data into the d ES, used the data available with published articles, or emailed the authors for the needed information. When studies provided separate information for vegans and vegetarians per outcome, we averaged the ESs within a given study to eliminate the biases and allow for the independence of the data (Lipsey & Wilson, 2001).

Because Cohen's d overestimates the effects in smaller samples, we used Hedges's g ESs with bias correction (Hedges, 1981; Hedges & Olkin, 1985). We used Cohen's rules of thumb to interpret the ESs (i.e., an ES of 0.20 = a small, 0.50 = a medium, & > 0.80 = a large effect) (Cohen, 1988) and the 95% level for confidence intervals (CIs) and prediction intervals.

The Cochran's Q statistic (Hedges & Olkin, 1985) was performed to assess variation in ESs or heterogeneity of distribution. In addition to Cochran's Q , we reported the I^2 statistic because Q statistic tends to have a small power, especially when the number of studies in a meta-analysis is small (Gavaghan et al., 2000). Also, the I^2 statistic informs about the percentage of the observed variance reflected differences in true ESs rather than sampling error, while Q statistic provides a statistical test of significance rather than the extent of heterogeneity (Higgins & Thompson, 2002; Huedo-Medina et al., 2006).

Given that we included studies from published literature, a random-effects model was used as the pooling method (Borenstein, 2019; Borenstein et al., 2011; Higgins & Thompson, 2004). We assessed publication bias by performing Begg rank correlation and Egger linear regression tests and inspecting the funnel plots (Begg & Mazumdar, 1994; Egger et al., 1997). For graphical representations of the ESs, we constructed forest plots.

Finally, a cumulative meta-analysis was used to test each study's effect on the findings, where each study was added to a random-effects model sequentially using the study rigor score — ranked from highest to lowest. The Comprehensive Meta-Analysis program Version 4.0. was used to calculate ESs and perform the statistical analyses (Borenstein et al., 2005). We considered a p -value of less than .05 significant for all statistical tests.

Results

Description of Literature Search and Studies

Initially, we found 6,644 potentially relevant articles. After the deduplication process, we screened 1,080 papers (i.e., titles and abstracts), which led to 57 articles. Each article was read and examined for inclusion/exclusion criteria. Most articles were excluded due to the lack of separate dietary groups ($n = 19$), were reviews/meta-analyses ($n = 8$), or examined irrelevant outcomes ($n = 6$). This qualitative process resulted in 19 papers, published between 2002 and 2023, that met our inclusion/exclusion criteria, including 16 cross-sectional (Baines et al., 2007; Baş et al., 2005; Beezhold et al., 2010; Boldt et al., 2018; Kaluza et al., 2023; Kessler et al., 2018; Krizanova & Guardiola, 2021; Lindeman, 2002; Nezlek et al., 2018; Norwood et al., 2019; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020; Quick & Byrd-Bredbenner, 2013; Schreiner et al., 2019; Timko et al., 2012), 2 mixed longitudinal and cross-sectional studies (Lavalley et al., 2019; Velten et al., 2018), and 1 RCT (Beezhold & Johnston, 2012). As per the Preferred Reporting Items for Systematic Review and Meta-Analyses statement (PRISMA) (Moher et al., 2009), results from each stage of the search process and study inclusion screening are displayed in Figure 1.

Participants' Characteristics and Assessment Methods

The total sample comprised 94,204 participants ($n_{males} = 35,549$, $n_{females} = 57,793$), with 82,449 individuals who consumed meat and 9,964 who abstained from meat consumption. The sizes of the samples ranged between 39 and 22,417 individuals, and the ages ranged between 13 and 102 years. In three articles, authors only recruited females (Baines et al., 2007; Kaluza et al., 2023; Lindeman, 2002). Five studies recruited participants from the U.S. (Beezhold & Johnston, 2012; Beezhold et al., 2010; Nezlek et al., 2018; Quick & Byrd-Bredbenner, 2013; Timko et

al., 2012), eleven from non-U.S. countries (e.g., Asia, Oceania, Europe) (Aslanifar et al., 2014; Baines et al., 2007; Baş et al., 2005; Boldt et al., 2018; Kaluza et al., 2023; Kessler et al., 2018; Krizanova & Guardiola, 2021; Lindeman, 2002; Norwood et al., 2019; Pfeiler & Egloff, 2018; Schreiner et al., 2019), and three studies recruited participants from varied national cohorts (Lavallee et al., 2019; Pfeiler & Egloff, 2020; Velten et al., 2018).

In all studies, positive psychological outcomes were assessed using established self-reported measures (e.g., RSES, WHOQOL-BREF) (Baines et al., 2007; Baş et al., 2005; Beezhold & Johnston, 2012; Beezhold et al., 2010; Boldt et al., 2018; Kaluza et al., 2023; Kessler et al., 2018; Lindeman, 2002; Quick & Byrd-Bredbenner, 2013; Schreiner et al., 2019; Timko et al., 2012) or assessments developed by authors using single- or multiple items (e.g., “When you think about the future, are you...?”) (Krizanova & Guardiola, 2021; Lavallee et al., 2019; Norwood et al., 2019; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020).

All studies used self-reported dietary assessment methods to assess dietary consumption (e.g., established FFQs, author-developed questionnaires) (Aslanifar et al., 2014; Baines et al., 2007; Baş et al., 2005; Beezhold & Johnston, 2012; Beezhold et al., 2010; Boldt et al., 2018; Kaluza et al., 2023; Kessler et al., 2018; Krizanova & Guardiola, 2021; Lavallee et al., 2019; Lindeman, 2002; Nezelek et al., 2018; Norwood et al., 2019; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020; Quick & Byrd-Bredbenner, 2013; Schreiner et al., 2019; Timko et al., 2012; Velten et al., 2018). Table 1 provides detailed information on the characteristics of participants and studies.

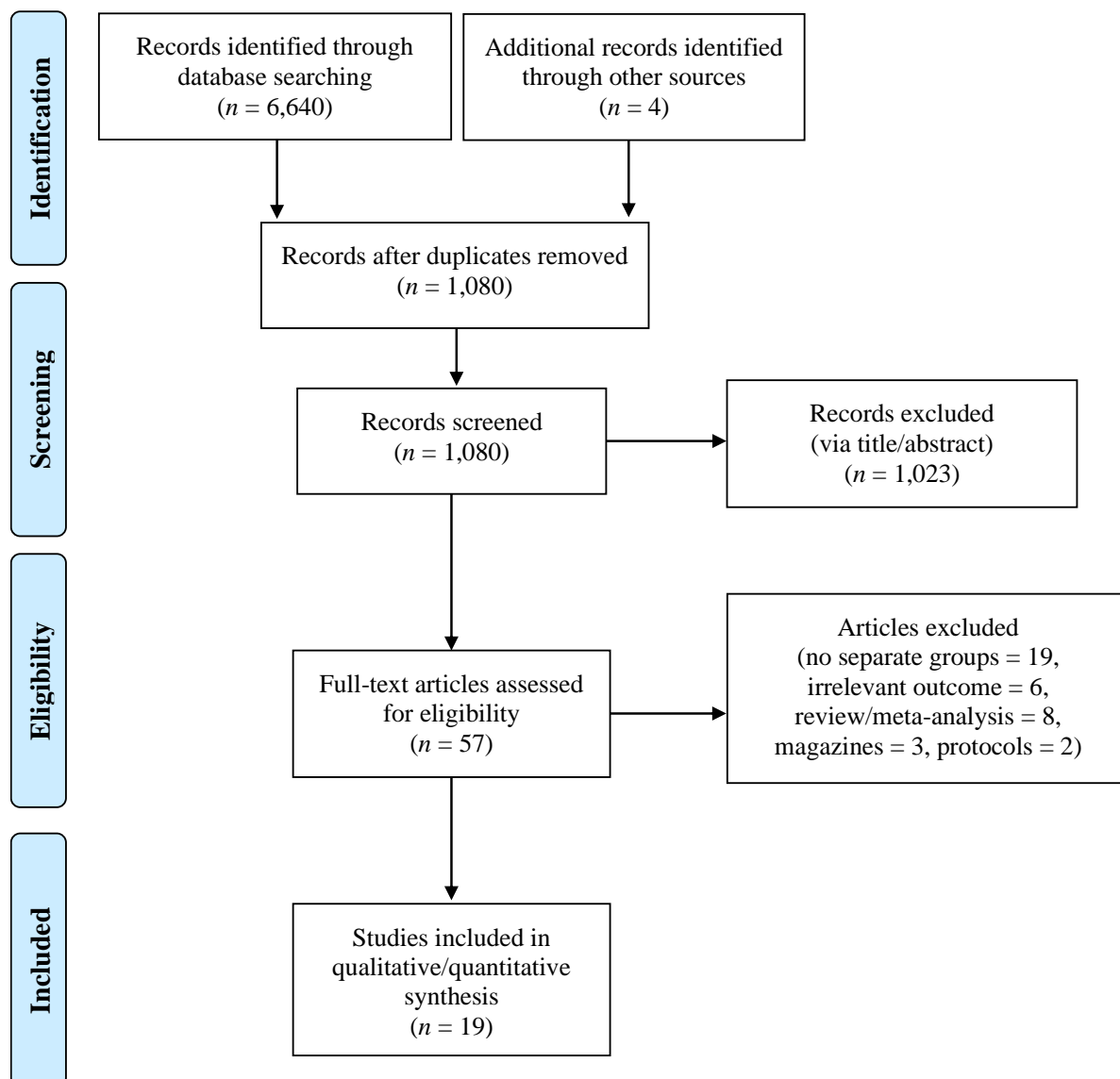


Figure 1 PRISMA Flow-Chart: Search Result

Methodologic Rigor Assessment

The study quality was between very low (5.26) and high (100), with an average score of 52.63. Studies were placed in five groups: 3 had very low quality (Aslanifar et al., 2014; Beezhold & Johnston, 2012; Quick & Byrd-Bredbenner, 2013), 5 had low quality (Beezhold et al., 2010; Kessler et al., 2018; Krizanova & Guardiola, 2021; Norwood et al., 2019; Schreiner et al., 2019), 3 had moderate-to-low quality (Boldt et al., 2018; Lindeman, 2002; Pfeiler & Egloff, 2018), 6 had moderate quality (Baş et al., 2005; Kaluza et al., 2023; Nezlek et al., 2018; Pfeiler & Egloff, 2020; Timko et al., 2012; Velten et al., 2018), and 2 had high quality (Baines et al., 2007; Lavalley et al., 2019). Inter-rater correlations between reviewers were good ($ICC = .75$; 95% CI: .34, .90, $p = .003$) (Koo & Li, 2016). This estimate changed to excellent after a session of elaborations. The following reasons contributed to heterogeneity in study quality: using cross-sectional designs, self-reported (diet and positive psychological outcomes) assessments, non-probability and biased sampling and recruitment techniques, not accounting for reactivity effects, and statistical and interpretive errors. Please see *Supplemental File 4* for details.

Heterogeneity & Publication Bias Assessment

The test of heterogeneity suggested that the true effect size is identical for studies that examined self-esteem [$Q(6) = 20.58$, $p = .002$; $I^2 = 71$] and positive mental health [$Q(3) = 12.29$, $p = .006$, $I^2 = 76$], but not life satisfaction [$Q(5) = 5.29$, $p = .38$; $I^2 = 5.0$]. Additionally, approximately 51% of the variance in the observed effects reflects variance in true effects rather than sampling error ($I^2_{mean} = 50.66\%$). The 95% prediction interval for self-esteem was -0.42 to 0.79, life satisfaction was -0.07 to 0.10, and positive mental health was -0.31 to 0.69.

The funnel plots for self-esteem, life satisfaction, and positive mental health are depicted in Figures 3 through 5 in *Supplemental File 3*, based on Hedges's g (x -axis) and SEs (y -axis). The Egger and Begg tests for self-esteem (intercept = 1.16, $t(5) = 0.61$, 95% CI [-3.75, 6.08], $p = .57$; Kendall's tau = 0.19, $p = .55$) and positive mental health (intercept = 2.92, $t(2) = 3.13$, 95% CI [-1.09, 6.93], $p = .09$; Kendall's tau = 0.17, $p = .73$) were not statistically significant and show no evidence of asymmetry of effects. However, while Begg's test (Kendall's tau = .67, $p = .06$) for life satisfaction was non-significant, Egger's test (intercept = -1.93, $t(4) = 3.77$, 95% CI [0.51, 3.35], $p = .02$) suggested potential publication bias.

Main Findings: Primary Outcomes

Individuals who consumed meat had higher self-esteem levels (in 7 studies) than individuals who abstained from meat consumption, but this relation was nonsignificant ($g = 0.20$, 95% CI [-0.01, 0.38], $p = .06$). Similarly, six studies of life satisfaction demonstrated a nonsignificant relation where individuals who consumed meat had higher levels of life satisfaction than individuals who abstained from meat consumption ($g = 0.02$, 95% CI [-0.04, 0.07], $p = .57$). Finally, meat consumers had higher positive mental health (in 4 studies) than meat abstainers ($g = 0.20$, 95% CI [0.08, 0.31], $p = .001$). However, the small size of this set of studies makes generalization difficult. Figure 2 depicts the forest plots for the bias-corrected Hedges's g values and their 95% CI for self-esteem, life satisfaction, and positive mental health.

Cumulative meta-analyses

Our cumulative meta-analyses demonstrated no clear patterns between study quality and group differences in self-esteem, life satisfaction, and positive mental health. Please see *Supplemental File 3*, Figures 6-8 for details.

Main Findings: Secondary Outcomes¹

Of the 19 studies, nine investigated the secondary outcomes of psychological well-being, positive affect, vigor, optimism, happiness, and meaning in life. Seven showed no significant differences between individuals who consumed meat and individuals who abstained from meat consumption (Beezhold & Johnston, 2012; Beezhold et al., 2010; Boldt et al., 2018; Kessler et al., 2018; Krizanova & Guardiola, 2021; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020), two favored meat abstainers (Aslanifar et al., 2014; Kaluza et al., 2023), and one provided mixed results (Nezlek et al., 2018).

Psychological Well-Being

Three studies examined psychological well-being. Specifically, Boldt et al. (2018) demonstrated that psychological well-being did not vary between individuals who consumed meat and individuals who abstained from meat consumption. Similarly, in a German sample of 197 medical professionals, Kessler et al. (2018) showed that meat abstainers and consumers did not differ in psychological well-being. However, in a cross-sectional sample of 636 females, Kaluza et al. (2023) found that vegans had better subjective well-being than vegetarians and meat consumers.

¹ Given that many studies examined multiple outcomes, the number of studies does not always match the number of outcomes.

Vigor

Three studies examined vigor (Beezhold & Johnston, 2012; Beezhold et al., 2010; Krizanova & Guardiola, 2021). Beezhold et al. (2010) examined vigor in a sample of 138 Seventh-Day Adventists and found no differences. Also, Beezhold and Johnson (2012) performed an RCT on 39 self-reported omnivores who were allocated to consume lacto-vegetarian, ovo-pescatarian, or omnivorous diet. After the trial, the groups showed no differences. Similarly, in their cross-sectional sample of 1,068 university students, Krizanova and Guardiola (2021) demonstrated that meat consumers and meat abstainers did not differ in vigor.

Positive Affect

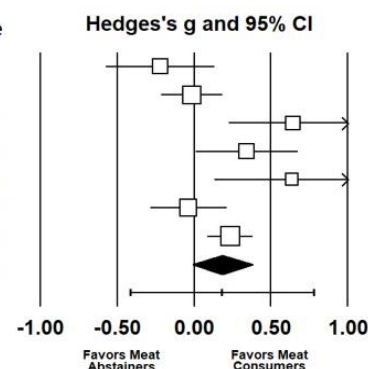
Two studies examined positive affect (Nezlek et al., 2018; Pfeiler & Egloff, 2020). Nezlek et al. (2018) explored positive emotions in a sample of 403 university students and found no differences between groups. Also, in a large sample ($n = 12,905$) of participants from Germany, Pfeiler and Egloff (2020) showed no difference in positive affect between individuals who consumed meat and individuals who abstained from meat consumption.

Optimism, Happiness, & Meaning in Life

Three studies examined optimism, happiness, and meaning in life (Aslanifar et al., 2014; Nezlek et al., 2018; Pfeiler & Egloff, 2018). Pfeiler and Egloff (2018) demonstrated no differences in optimism between individuals who consumed meat and individuals who abstained from meat consumption. Aslanifar et al. (2014) examined happiness in a sample of 300 Iranian adult individuals and showed that meat abstention was linked to greater happiness levels. Conversely, Nezlek et al. (2018) examined meaning in life and found that individuals who consumed meat scored higher on meaning in life than those who abstained from meat consumption.

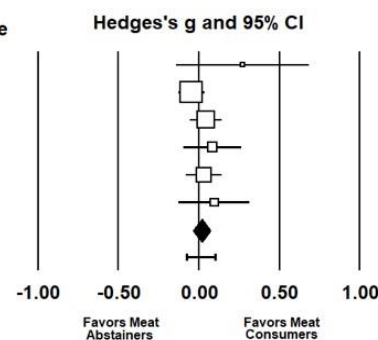
Self-Esteem

Study	Hedges's g	Lower limit	Upper limit	p-Value
Bas et al. (2005)	-0.220	-0.576	0.137	0.228
Timko et al. (2012)	-0.015	-0.217	0.187	0.884
Nezlek et al. (2018)	0.643	0.226	1.059	0.002
Lindeman (2002): Study 1	0.343	0.010	0.677	0.044
Lindeman (2002): Study 2	0.636	0.132	1.141	0.013
Norwood et al. (2019)	-0.037	-0.288	0.215	0.775
Quick et al. (2013)	0.235	0.085	0.384	0.002
Pooled	0.183	-0.011	0.377	0.065
Prediction Interval	0.183	-0.413	0.780	



Life Satisfaction

Study	Hedges's g	Lower limit	Upper limit	p-Value
Nezlek et al. (2018)	0.272	-0.143	0.686	0.199
Pfeiler & Egloff (2020): Study 1	-0.046	-0.124	0.032	0.245
Pfeiler & Egloff (2020): Study 2	0.043	-0.058	0.145	0.404
Pfeiler & Egloff (2018): Study 1	0.084	-0.095	0.263	0.358
Pfeiler & Egloff (2018): Study 2	0.030	-0.086	0.145	0.616
Krizanova & Guardiola (2020)	0.096	-0.122	0.314	0.390
Pooled	0.015	-0.038	0.068	0.572
Prediction Interval	0.015	-0.072	0.103	



Positive Mental Health

Study	Hedges's g	Lower limit	Upper limit	p-Value
Baines et al. (2006)	0.198	0.072	0.323	0.002
Lavallee et al. (2019)	0.087	0.042	0.133	0.000
Velten et al. (2019)	0.269	0.154	0.385	0.000
Schreiner et al. (2019)	0.341	0.064	0.619	0.016
Pooled	0.196	0.079	0.313	0.001
Prediction Interval	0.196	-0.297	0.689	

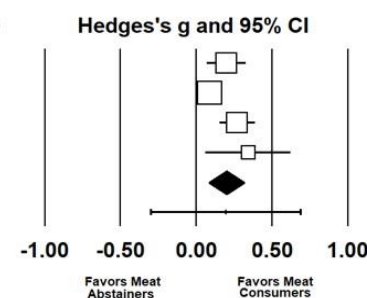


Figure 2. Forest plots for Hedges's g and 95% confidence intervals (CIs) for self-esteem, life satisfaction, and positive mental health between meat abstainers and meat consumers arranged high to very low quality scores.

Table 2 includes the findings of the primary outcomes and secondary outcomes.

Primary	Favored Meat Consumers (<i>n</i> = 51,403)	NS findings (<i>n</i> = 79,426)	Favored Meat Abstainers (<i>n</i> = 0)
Self-Esteem	Lindeman (2002): Study 1 & 2 Nezlek et al. (2018)* Quick et al. (2013)	Bas et al. (2005) Timko et al. (2012) Norwood et al. (2019)	
Life Satisfaction		Krizanova & Guardiola (2021) Nezlek et al. (2018)* Pfeiler & Egloff (2018): Study 1 & 2 Pfeiler & Egloff (2020): Study 1 & 2	
Positive Mental Health	Baines et al. (2007) Schreiner et al. (2017) Lavallee et al. (2019)* Velten et al. (2018)*	Lavallee et al. (2019)* Velten et al. (2018)*	
Secondary	Favored Meat Consumers (<i>n</i> = 403)	NS findings (<i>n</i> = 38,461)	Favored Meat Abstainers (<i>n</i> = 936)
Psychological Well-Being		Boldt et al. (2018) Kessler et al. (2018)	Kaluza et al. (2023)
Positive Affect/Emotions		Nezlek et al. (2018)* Pfeiler & Egloff (2020): Study 1 & 2	
Vigor/Vitality		Beezhold et al. (2010) Beezhold et al. (2012) Krizanova & Guardiola (2021)	
Optimism		Pfeiler & Egloff (2018): Study 1 & 2	
Happiness			Aslanifar et al. (2014)
Meaning in life	Nezlek et al. (2018)*		

Table 2 The Findings of the Studies on All Outcomes Included in the Review

Note. *Lavallee et al. (2019) & Velten et al. (2018) showed mixed findings in their cross-sectional & longitudinal analyses; Nezlek et al. (2018) showed mixed results on four outcomes (see Table 1); *n* = sample size; NS = no significant findings.

Discussion

This systematic and meta-analytic review extends the findings of our prior scoping review (Dobersek et al., 2024) by presenting a quantitative evaluation of the diet-*health* relations. We found 19 studies that examined positive psychological functioning between individuals who consumed meat and individuals who abstained from meat consumption and met our criteria. The studies had 94,204 participants aged between 13 and 102 from Asia, Oceania, North America, and Europe.

A meta-analysis of primary outcomes demonstrated that individuals who consumed meat had greater positive mental health than individuals who abstained from meat consumption (Baines et al., 2007; Lavallee et al., 2019; Schreiner et al., 2019; Velten et al., 2018), while studies examining self-esteem and life satisfaction found no significant differences between the groups (Baş et al., 2005; Krizanova & Guardiola, 2021; Lindeman, 2002; Nezlek et al., 2018; Norwood et al., 2019; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020; Quick & Byrd-Bredbenner, 2013; Timko et al., 2012). Similarly, a qualitative analysis of studies examining secondary outcomes of psychological well-being, positive affect, vigor, and optimism showed no group differences (Beezhold & Johnston, 2012; Beezhold et al., 2010; Boldt et al., 2018; Kessler et al., 2018; Krizanova & Guardiola, 2021; Nezlek et al., 2018; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020). However, one study found that meat consumption was associated with greater meaning in life (Nezlek et al., 2018), and two studies showed that meat abstainers had greater psychological well-being or happiness than meat consumers (Aslanifar et al., 2014; Kaluza et al., 2023). Our cumulative analyses of study quality on diet-*health* relations did not support prior findings on diet-*disease* relations (Dobersek et al., 2021). Specifically, the lack of representation of varied methodologic rigor of studies examining self-esteem, life satisfaction, and positive mental health renders definitive findings equivocal.

Overall, our findings on diet-*health* relations are less definitive compared to prior evidence on diet-*disease* relations (Dobersek et al., 2021; Dobersek, Wy, et al., 2020). These inconclusive results offer various interpretations. First, omnivorous dietary patterns may serve as a ‘protective’ or ‘preventive’ mechanism for mental

health pathologies due to their essential nutritional components (e.g., vitamins, calcium, iron, etc.), as evidenced by the previous research (Dobersek et al., 2021; Dobersek, Wy, et al., 2020). On the other hand, non-restrictive dietary patterns could have little or no effect on positive mental health and other positive psychological outcomes.

Second, individuals abstain from meat and/or animal-based products for many reasons (e.g., ethical, environmental, health, weight control, camouflage, taste preference, cultural, religious, and familial traditions) (Fox & Ward, 2008; Jabs et al., 1998; Timko et al., 2012). As such, the psychological consequences could be as diverse as the motives behind excluding meat from the diet. For example, individuals abstaining from meat due to animal welfare or ecological reasons may experience greater anxiety and, at the same time, feel better about themselves (i.e., have greater levels of psychological well-being) compared to individuals abstaining from animal products due to health concerns (Brown & Kasser, 2005). Third, consequences associated with adherence to restrictive diets (veganism, vegetarianism) may not be because of the avoidance of meat in itself but some other reasons or variables related to the lifestyle associated with plant-based diets (e.g., levels of physical activity, low alcohol, tobacco, or drug consumption) (Archer, Lavie, et al., 2018a; O'Keefe et al., 2018). This complexity yields findings on diet-*health* relations that are inconclusive.

Strengths and Limitations of the Current Literature

Sampling and recruitment strategies

Studies of higher quality investigated large, randomly selected, and representative samples (Baines et al., 2007; Lavalley et al., 2019). For example, Baines et al. (2007) used a large, representative, random sample of women from Australia. Similarly, Lavalley et al. (2019) employed large, representative samples from multinational cohorts of Germany, Russia, and the USA. The findings from these studies are more generalizable compared to findings from nonrepresentative samples that were employed by less rigorous studies. For example, many studies used biased recruitment strategies and convenience sampling protocols that attempted to over-sample meat abstainers using targeted advertisements via social media platforms, websites, fairs, and conferences (Beezhold & Johnston, 2012; Beezhold et al., 2010; Kessler et al., 2018). Using these strategies can result in many issues, including unreliable data and selection bias, leading to questionable results.

Dietary assessment methods

All studies in this review employed self-reported dietary status. Given the current controversial debate on the plausibility of dietary recalls and memory-based assessment protocols, this is potentially a major limitation. Specifically, self-reported dietary intake data and other FFQs result in non-falsifiable (i.e., pseudo-scientific) and physiologically implausible data (Archer et al., 2013; Archer, Lavie, et al., 2018b; Archer, Marlow, et al., 2018a, 2018b; Archer et al., 2015). Therefore, the difference in self-reported and actual dietary food intake may show definitive results impossible when examining the consumption of meat on a continuous scale rather than dichotomous (Archer et al., 2013; Archer, Lavie, et al., 2018b; Archer, Marlow, et al., 2018a, 2018b; Archer et al., 2015).

Additionally, most studies did not assess the age at which individuals became meat abstainers, how long they have been vegans or vegetarians, or their reasons for adopting restrictive diets. If there are any associations among these variables (e.g., length that people refrain from meat consumption, motives for adopting a restrictive diet), obtaining this information is essential for further research.

Positive psychological functioning assessment methods

Similar to dietary measures, all 19 studies employed self-reported positive psychological assessment methods. They ranged from previously used, psychometrically sound questionnaires (e.g., RSES, POMS-V, WHOQOL-BREF) (Baş et al., 2005; Beezhold & Johnston, 2012; Beezhold et al., 2010; Lindeman, 2002; Nezlek et al., 2018; Timko et al., 2012) to author-developed assessments employing single- or multiple-items with unreported/untested validity (Krizanova & Guardiola, 2021; Nezlek et al., 2018; Pfeiler & Egloff, 2018; Pfeiler & Egloff, 2020). Using assessments with potentially uncertain validity could result in unclear findings.

Additionally, studies varied in how the psychological assessments were used. For example, some studies used questionnaires to assess traits and general feelings (Baines et al., 2007; Baş et al., 2005; Beezhold & Johnston, 2012; Beezhold et al., 2010; Boldt et al., 2018; Kaluza et al., 2023; Kessler et al., 2018; Pfeiler & Egloff, 2018), while others assessed psychological constructs over the past few weeks or how individuals felt at the moment or that day (Krizanova & Guardiola, 2021; Nezlek et al., 2018; Pfeiler & Egloff, 2020). Employing psychological questionnaires assessing traits vs. states can lead to inconclusive findings.

Potential confounding variables

Many studies did not report controlling for confounding variables and/or provided limited characteristics about participants that did not allow for testing any covariates (e.g., age of diet adoption or length of diet, BMI), which could potentially contribute to study quality and between-studies heterogeneity. Given that diet is not the only

contributing factor to mental health and positive psychological functioning, it is important to control for potential confounding variables or collect relevant participant information.

Strengths and Limitations of this Review

This review had strengths and limitations. This is the first meta-analytic review (to our knowledge) that synthesized the existing evidence on positive psychological outcomes between individuals who consumed meat and individuals who abstained from meat consumption. While previous reviews examined diet-*health* relations, they did not clearly distinguish physical health from psychological health (Govindaraju et al., 2018; Vajdi & Farhangi, 2020; Wu et al., 2017). However, this also necessitated omitting many studies that did not distinguish mental health from physical health (Corley et al., 2020; Ding et al., 2021; Jiang et al., 2020).

Second, including only studies that clearly distinguished between meat abstainers and meat consumers allowed for a thorough review. Nevertheless, this is also a limitation because many studies were excluded due to dietary status being assessed on a continuous scale. A consequence of this stringent inclusion criteria resulted in a small number of studies, which prevented us from performing meta-regression on primary outcomes to examine potential moderators and explain heterogeneity between studies. According to the latest version of the Cochrane Handbook, a minimum of 10 studies per examined covariate is needed for meta-regression (Higgins et al., 2008).

Third, given that the incidence and prevalence of individuals who omit all animal-based products (i.e., vegans) are small in most populations (Kamiński et al., 2020; Statista, 2023), for some studies, we combined vegetarians and vegans into one group. Therefore, conclusions regarding vegans (i.e., individuals eliminating all animal-based products) are conflated with vegetarians (i.e., individuals eliminating some animal-based products). As such, there is a need to examine the differences among the different types of meat abstention.

Another limitation of our review is the inclusion of English-language studies only, potentially biasing our findings towards 'Western' cultural norms — which often embrace meat consumption, possibly leading to the oversight of research from regions where vegetarian or plant-based diets are more common. We also did not search grey literature because it is rarely peer-reviewed (Corlett, 2011). Finally, temporal and causal inferences cannot be made because most studies included in this review were cross-sectional.

Recommendations for Future Directions

In our previous reviews conducted from a diet-*disease* perspective, we showed that study quality explained almost 80% of between-study heterogeneity (Dobersek, Stallings, et al., 2020; Dobersek et al., 2021). Due to a small number of studies, we were unable to perform meta-regression to quantify the role of methodological rigor. However, based on our qualitative analyses, we offer a few recommendations for future research.

First, researchers should recognize the limitations of nonprobability sampling and biased recruitment techniques or, when possible, use probability sampling strategies (e.g., random sampling). Additionally, when using highly selective or biased samples, investigators must consider the effects of participant and researcher biases (e.g., reactivity, confirmation bias, cognitive dissonance), given that individuals are susceptible to misreporting ((non)-intentional) when they are greatly devoted to their eating patterns.

Second, given the limitations of self-report measures, studies should use more objective data collection methods for diet and positive mental health outcomes or at least acknowledge their limitations. For instance, although biological marker data (e.g., barcode or 'point-of-purchase') might not accurately reflect actual dietary consumption (Ng & Popkin, 2012), it may overcome some of the limitations of self-reported dietary patterns. Also, employing objective or unobtrusive measures to examine positive psychological functioning, such as behaviors (e.g., frequency of laughing, smiling), may potentially decrease the effects of research artifacts (e.g., social desirability, demand characteristics).

Third, using RCTs or other more rigorous designs is preferable over cross-sectional research. Nevertheless, performing an RCT of a dietary regimen that would be long enough to influence traits such as self-esteem and well-being might be challenging. Fourth, thorough information about participants' health, lifestyles, and behavioral histories is essential for valid inferences. The inclusion of more detailed reporting would allow researchers to extract relevant study and participant characteristics to examine additional questions (e.g., is a time or length of diet adoption related to positive mental health?). Additionally, per current reporting standards (Appelbaum et al., 2018), we encourage researchers to provide thorough information on statistics to allow for the calculations of ESs. Finally, more (high-quality) research on diet-*health* relations is needed for valid and reliable inferences and the examination of potential moderators to explain heterogeneity between studies.

Conclusion

This systematic and meta-analytic review extended our scoping review (Dobersek et al., 2024) and provided evidence to inform the public, researchers, policy-makers, and clinicians. Our meta-analysis of primary outcomes

showed that individuals who consumed had greater positive mental health. While qualitative analysis suggested that most studies examining secondary outcomes showed no group differences, a small minority showed conflicting results—some favoring meat consumers and some meat abstainers. Our cumulative analyses showed no clear pattern in the association between methodologic rigor and positive mental health outcomes across studies. However, the extant research precludes causal and temporal inferences.

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Competing interests:

UD, MB, AE, & GFG previously received funding from the Beef Checkoff, through the National Cattlemen's Beef Association.

Author's contributions:

UD; Methodology: all authors; Formal analysis and investigation: all authors; Writing-original draft preparation: UD; Writing-review and editing: all authors; Funding acquisition: UD; Supervision: UD.

Availability of Data & Material:

Data are available upon request.

Consent for Publication:

Not applicable because it is a review article.

Ethical Approval:

Not applicable because it is a review article.

Supplemental File 1**Search Strategy****Databases searched:**

- PubMed, PsycINFO, CINAHL Plus, Cochrane Library, Web of Science

Filters: Humans only; search only in title and/or abstracts; English language

Keywords (as entered in the databases):

(beef OR meat OR carnivore OR omnivore OR herbivore OR vegan OR vegetarian OR “plant-based”)

AND

(happiness OR “life purpose” OR “life satisfaction” OR “meaning in life” OR “meaning of life” OR “mental health” OR “mental positivity” OR “mental strength” OR “mental well-being” OR optimism OR “personal satisfaction” OR “positive affect” OR “positive emotion” OR “positive mental health” OR “positive psychology” OR “psychological health” OR “psychological positivity” OR “psychological well-being” OR “quality of life” OR “life quality” OR “satisfaction with life” OR self-esteem OR self-worth OR vigor OR vitality)

Hand searches of the previous systematic reviews and meta-analyses and references of the relevant articles.

Search Strategy	Details
Inclusion criteria	P: Humans
	E/I/C: Clear distinction between meat consumers and meat abstainers
	O: Constructs related to positive psychology, psychological benefits, and outcomes (e.g., optimism, life satisfaction, happiness, flow, grit, mental toughness, resilience, etc. – please see <i>Supplemental File 1</i> for an exhaustive list of key terms)
	S: Observational studies (e.g., cross-sectional, longitudinal, case-control), non-/randomized control trials (RCTs)
Exclusion criteria	P: Animals
	E/I/C: Plant-based diets only; no clear distinction between meat consumers and meat abstainers (e.g., Mediterranean diets, FFQs, etc.)
	O: Outcomes unrelated to positive psychological constructs (e.g., mental illnesses, disorders, diseases, physical health, nutritional outcomes, etc.); unable to distinguish psychological from physical outcomes
	S: Qualitative studies, reviews, letters, books, book chapters, articles without quantitative data, magazines
Language	English
Time filter	None
Database	PubMed, PsycINFO, CINAHL Plus, Medline with full text, Cochrane Library, Web of Science

Note. FFQs = Food Frequency Questionnaires, N/A = Not Applicable, P = Population, E/I/C = Exposure/Intervention/Comparison, O = Outcomes, S = Study Design.

Table 3 Detailed description of selection criteria according to the PE/I/COS Framework (Brown et al., 2006; Huang et al., 2006)

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- Brown, P., Brunnhuber, K., Chalkidou, K., Chalmers, I., Clarke, M., Fenton, M., Forbes, C., Glanville, J., Hicks, N. J., Moody, J., Twaddle, S., Timimi, H., & Young, P. (2006). How to formulate research recommendations. *BMJ (Clinical research ed.)*, 333(7572), 804-806. <https://doi.org/10.1136/bmj.38987.492014.94>
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Supplemental File 2
Assessment of Study Quality

Each study was assessed for its quality via appraisals of the risk of bias, validity of interpretation, and confidence in findings by two investigators working independently while employing a 100-point scale of the predetermined criteria below. Given the interdisciplinary nature of the topic, the scale was adopted from our previous reviews (Dobersek et al., 2021; Dobersek et al., 2020) developed via an amalgam of multiple tools and checklists (Hong et al., 2018; Weightman et al., 2004). Studies were grouped into very low quality (scores 0–19), low quality (scores 20–39), moderate-to-low quality (scores 40–59), moderate quality (scores 60–89), and high quality (scores 90–100).

Criteria and weighting for assessment:

- 1) Introduction: (0-5 Points)**
 - a. Background
 - b. Accurate and balanced presentation of prior research
 - c. Hypothesis or research question clearly articulated in context of previous research.
- 2) Study Design: (0-5 Points)**
 - a. Does the design adequately address the research question?
- 3) Recruitment and Sampling: (0-15 Points)**
 - a. Clear description of recruitment strategy
 - b. Was strategy unbiased and/or valid?
 - c. Clearly articulated biases and non-response rate
- 4) Description of Research Population: (0-10 Points)**
 - a. Were the participants' characteristics fully presented?
 - b. Is the population representative of the general or target population?
- 5) Assessment of Dietary Intake: (0-5 Points)**
 - a. Were the methods employed valid and appropriate?
- 6) Assessment of Psychological Outcomes: (0-10 Points)**
 - a. Were the methods employed valid and appropriate?
- 7) Statistical Assessment: (0-10 Points)**
 - a. Were appropriate statistical methods used for main analysis and adjustment of potential confounders?
 - b. Comprehensiveness of approach
- 8) Interpretation and Communication of Results: (0-15 Points)**
 - a. Did the data collected address the research question?
 - b. Results interpreted appropriately based on study design and statistics
 - c. Appropriate presentation of results in the context of prior research
- 9) Overall Critique: (0-25 Points)**
 - a. Are the conclusions supported by the results?
 - b. Was the language appropriate to the design?
 - i. E.g., causal language used in correlational research design

Reference

- Dobersek, U., Teel, K., Altmeyer, S., Adkins, J., Wy, G., & Peak, J. (2021). Meat and mental health: A meta-analysis of meat consumption, depression, and anxiety. *Critical Reviews in Food Science and Nutrition*, 1-18. <https://doi.org/10.1080/10408398.2021.1974336>
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Supplemental File 3

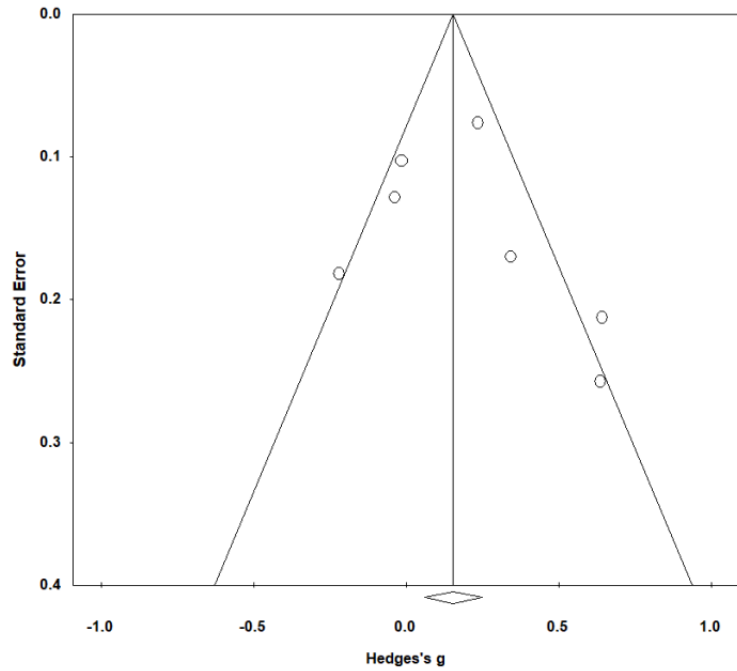


Figure 3. Funnel plot of standard error and Hedges's g for differences in self-esteem between meat abstainers and meat consumers.

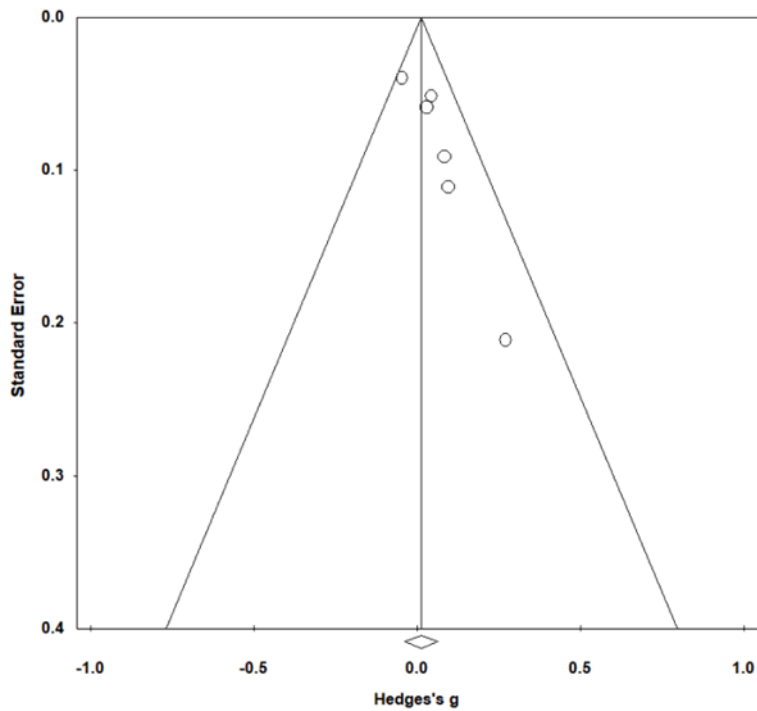


Figure 4. Funnel plot of standard error and Hedges's g for differences in life satisfaction between meat abstainers and meat consumers.

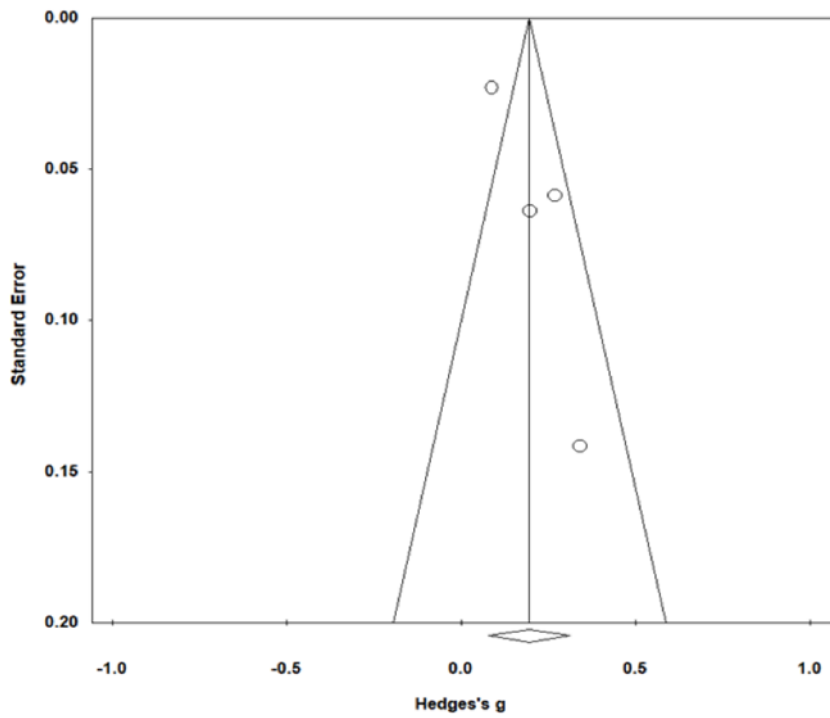


Figure 5. Funnel plot of standard error and Hedges's *g* for differences in positive mental health between meat abstainers and meat consumers.

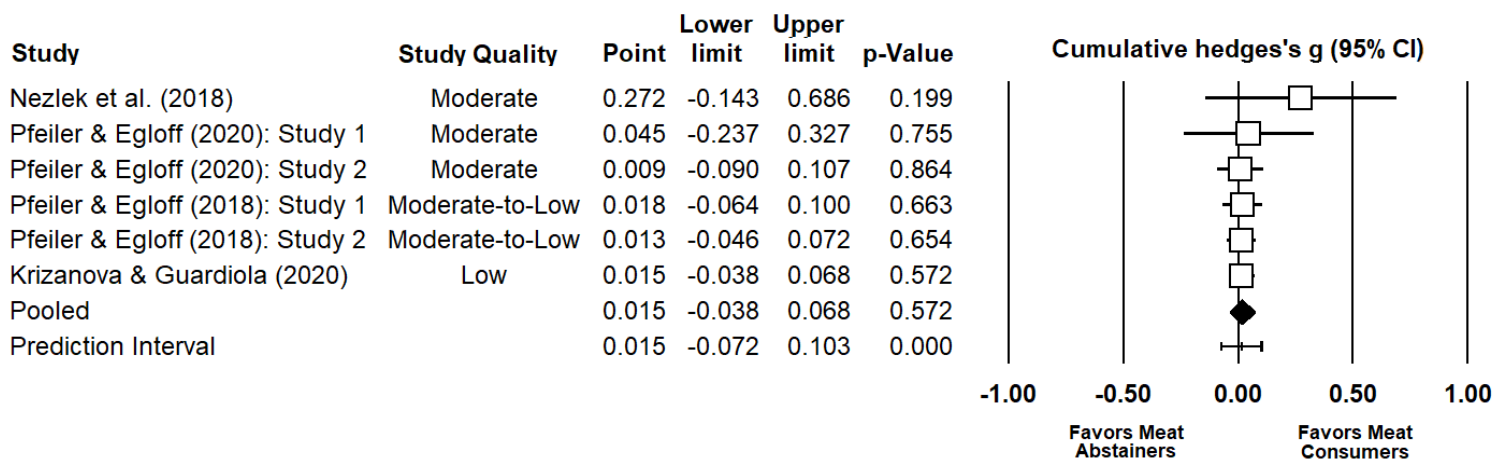


Figure 6. Cumulative meta-analysis for self-esteem between meat abstainers and meat consumers.

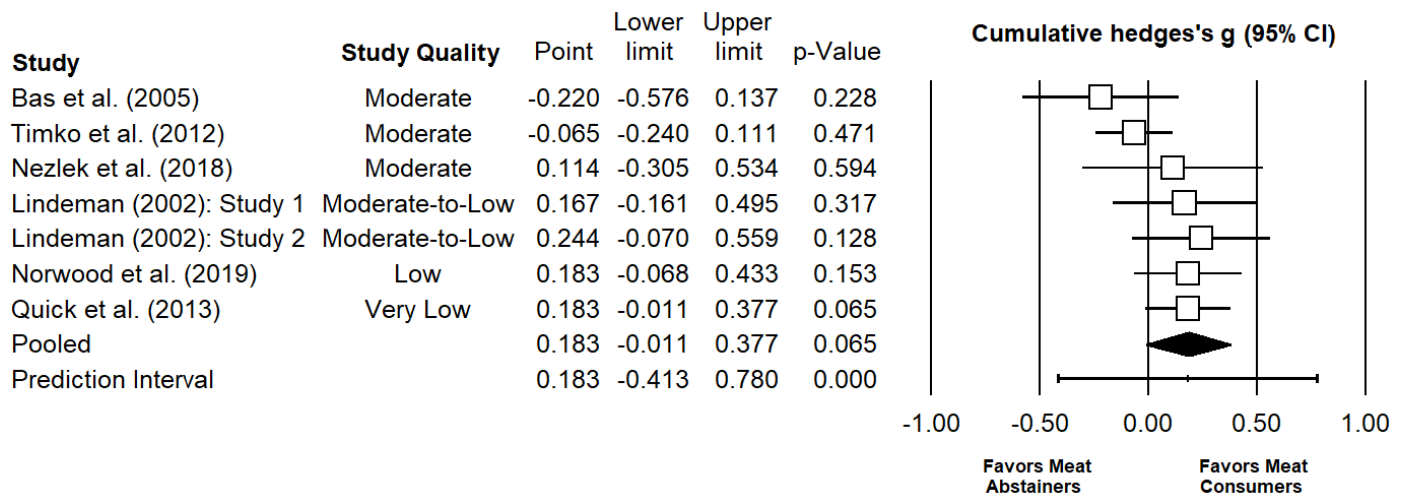


Figure 7. Cumulative meta-analysis for life satisfaction between meat abstainers and meat consumers.

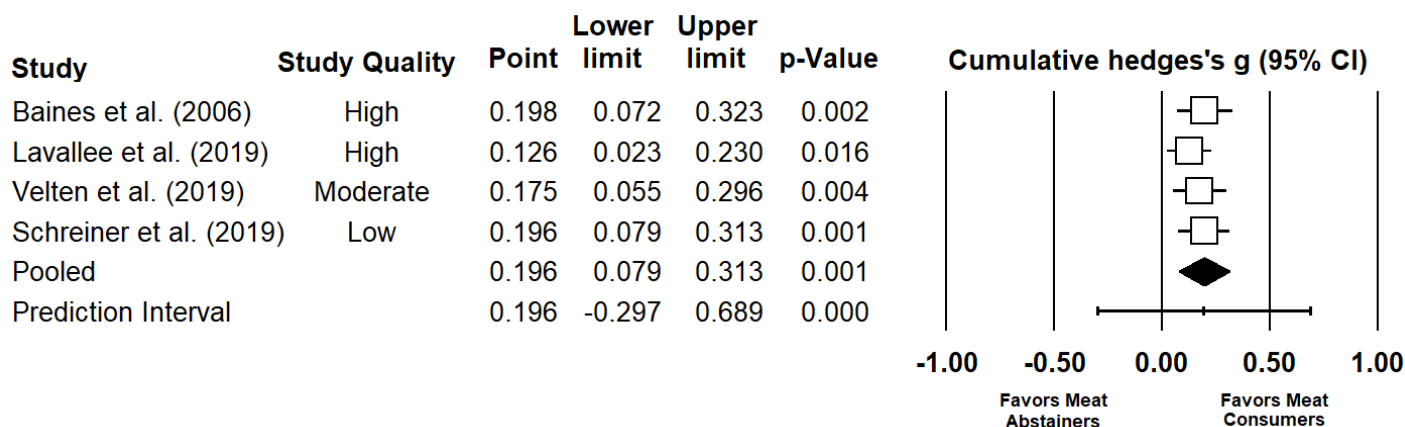


Figure 8. Cumulative meta-analysis for positive mental health between meat abstainers and meat consumers.

Supplemental File 4

Results: Risk of Bias, Strengths, and Limitations Ranked by Methodologic Rigor

Note: FFQ = Food Frequency Questionnaire; IBD = Inflammatory Bowel Disease; The RSES = The Rosenberg Self-Esteem Scale; SF = short form; The POMS-V = The Profile of Mood States-Vigor; The PMH = The Positive Mental Health; WHO = World Health Organization; The WHOQOLA-BREF = The World Health Organization Quality of Life Assessment

Study and Assessment of Rigor	Major Strengths	Major Limitations/Weaknesses	Confidence in Results
<p>Baines et al. (2007)</p> <p>High rigor and low risk of bias</p>	<ul style="list-style-type: none"> Large, representative, random sample of women (Australian) SF-36 is a well-established tool Detailed socio-demographic and behavioral history 	<ul style="list-style-type: none"> Cross-sectional design Self-reported dietary status with details Self-reported psychological outcomes 	<p>High confidence in results:</p> <p>Women who avoided meat consumption had poorer positive mental health than meat consumers.</p> <p>No evidence of a causal relation.</p>
<p>Lavallee et al. (2019)</p> <p>High rigor and low risk of bias</p>	<ul style="list-style-type: none"> Multi-national design Multiple designs (longitudinal and cross-sectional) Detailed demographic information The PMH is appropriate for cross-cultural research 	<ul style="list-style-type: none"> No intra-country group statistics reported Very low response rates and large disparities between countries Variability in sampling strategies between countries Self-reported dietary status Self-reported psychological outcomes 	<p>High confidence in results:</p> <p>In Russian sample in cross-sectional study, meat abstinence was associated with lower PMH. No associations in the German or Russian samples in longitudinal study.</p> <p>No evidence of a causal relation.</p>
<p>Velten et al. (2018)</p> <p>Moderate rigor and risk of bias</p>	<ul style="list-style-type: none"> Large German and Chinese sample PMH is well-established 	<ul style="list-style-type: none"> Convenience sample of students Self-reported dietary status 	<p>Moderate confidence in results:</p> <p>In both German and matched sample in a cross-sectional study, vegetarian diet was associated with lower mental health. No</p>

	<ul style="list-style-type: none"> Multiple designs (longitudinal and cross-sectional) 	<ul style="list-style-type: none"> Self-reported psychological outcomes 	<p>association in Chinese sample.</p> <p>In Chinese sample in a longitudinal study, vegetarian diet was associated with lower mental health, but not in German sample.</p> <p>No evidence of causal relation.</p>
<p>Bas et al. (2005)</p> <p>Moderate rigor and risk of bias</p>	<ul style="list-style-type: none"> Large, multistage cluster sample (Turkish) RSES is well-established; strong reliability and validity established in Turkish students Collected information on duration of meat abstinence 	<ul style="list-style-type: none"> Cross-sectional design Limited sample (i.e., university students in a single city) Self-reported dietary status without details Self-reported inventories for self-esteem 	<p>Moderate confidence in results:</p> <p>No statistically significant differences between meat abstainers and meat consumers in self-esteem levels.</p> <p>No evidence of a causal relation.</p>
<p>Timko et al. (2012)</p> <p>Moderate rigor and risk of bias</p>	<ul style="list-style-type: none"> Detailed demographic information Multiple strategies to assess dietary status RSE is well-established Collected information on duration of meat abstinence 	<ul style="list-style-type: none"> Cross-sectional design Limited convenience sample (two urban universities) and biased recruitment strategies Self-reported dietary status with FFQ Self-reported psychological outcomes 	<p>Moderate confidence in results:</p> <p>No statistically significant differences in self-esteem between meat consumers and meat abstainers</p> <p>No evidence of a causal relation.</p>
<p>Kaluza et al. (2018)</p> <p>Moderate rigor and risk of bias</p>	<ul style="list-style-type: none"> The WHO-5 is well-established Detailed demographic information Detailed statistical analyses 	<ul style="list-style-type: none"> Cross-sectional design Limited, non-representative sample of Polish women Self-reported dietary status Self-reported psychological outcomes 	<p>Moderate confidence in results:</p> <p>Meat abstainers had higher subjective well-being.</p> <p>No evidence of a causal relation.</p>
<p>Nezlek et al. (2018)</p> <p>Moderate rigor and risk of bias</p>	<ul style="list-style-type: none"> Adopted a well-established RSES Detailed statistical analyses 	<ul style="list-style-type: none"> Convenience sample of students Cross-sectional design Self-reported dietary status with details Self-reported psychological outcomes 	<p>Moderate confidence in results:</p> <p>Meat abstainers had lower self-esteem. No differences between the groups on life satisfaction, and positive activated and deactivated emotions.</p> <p>No evidence of a causal relation.</p>
<p>Pfeiler & Egloff (2020)</p> <p>Moderate rigor and risk of bias</p>	<ul style="list-style-type: none"> Two large representative samples (German, Australian) Two separate studies examining the same variables employing different definitions of meat abstainers 	<ul style="list-style-type: none"> Cross-sectional design No information on response rate 	<p>Moderate confidence in results:</p> <p>No statistically significant group differences in positive affect and life satisfaction after controlling for sociodemographic variables.</p>

		<ul style="list-style-type: none"> • Self-reported dietary status • Self-reported psychological outcomes; a single item for positive affect and life satisfaction 	No evidence of causal relations.
Boldt et al. (2018) Moderate-to-low rigor and moderate-to-high risk of bias	<ul style="list-style-type: none"> • WHOQOLA-BREF is well-established 	<ul style="list-style-type: none"> • Cross-sectional design • Extremely biased recruitment • Limited sample: recreational runners • Self-reported dietary status with details • Self-reported psychological outcomes 	Moderate-to-Low confidence in results: No significant differences in psychological well-being between groups. No evidence of a causal relation.
Pfeiler & Egloff (2018) Moderate-to-low rigor and moderate-to-high risk of bias	<ul style="list-style-type: none"> • Large representative sample (German) • Two separate studies examining the same variables employing different definitions of meat abstainers 	<ul style="list-style-type: none"> • Cross-sectional design • No information on response rate • Self-reported dietary status • Self-reported psychological outcomes; a single item for each outcome—life satisfaction and optimism 	Moderate-to-Low confidence in results: No statistically significant group differences in life satisfaction and optimism after controlling for sociodemographic variables. No evidence of causal relations.
Lindeman (2002) Moderate-to-low rigor and moderate-to-high risk of bias	<ul style="list-style-type: none"> • Low non-response rate • RSES is a well-established, valid, and reliable tool to assess global self-worth • Self-Worth subscale of the World Assumption Scale—frequently used in trauma research 	<ul style="list-style-type: none"> • Limited, non-representative sample of university students from a single city during summer; excluded males after data collection • Self-administered psychological assessment that captured self-esteem • Self-reported dietary status with no details 	Moderate-to-Low confidence in results: Women who avoided meat consumption had lower self-esteem than meat consumers. No evidence of a causal relation.
Krizanova & Guardiola (2021) Low rigor and high risk of bias	<ul style="list-style-type: none"> • Detailed demographic information • Detailed statistical analyses 	<ul style="list-style-type: none"> • Cross-sectional design • Convenience sample university students • Self-reported dietary status • Self-reported psychological outcomes; a single item for life satisfaction 	Low confidence in results: Meat abstainers and meat consumers did not differ in life satisfaction and vitality. No evidence of a causal relation.
Shreiner et al. (2019)	<ul style="list-style-type: none"> • Large, representative sample of patients with IBD (Switzerland) • SF-36 is a well-established tool 	<ul style="list-style-type: none"> • Limited sample to patients with IBD • Cross-sectional design 	Low confidence in results: Patients who avoided meat consumption had poorer

<p>Low rigor and high risk of bias</p>	<ul style="list-style-type: none"> Moderate response rate for dietary patterns questionnaire (66%) Detailed health information 	<ul style="list-style-type: none"> Self-reported dietary status with details Self-reported psychological outcomes 	<p>positive mental health than meat consumers.</p> <p>No evidence of a causal relation.</p>
<p>Beezhold et al. (2010)</p> <p>Low rigor and high risk of bias</p>	<ul style="list-style-type: none"> POMS-V is well-established 	<ul style="list-style-type: none"> Cross-sectional design Small, biased sample (i.e., Seventh Day Adventists: a religious group that proselytizes vegetarianism) High risk of misreporting due to the avoidance of cognitive dissonance and social desirability Self-reported dietary status using FFQ Self-reported psychological outcomes 	<p>Low confidence in results:</p> <p>Meat abstainers and meat consumers did not differ in vigor.</p> <p>No evidence of a causal relation.</p>
<p>Norwood et al. (2019)</p> <p>Low rigor and high risk of bias</p>	<ul style="list-style-type: none"> Collected information on the duration of dietary patterns Detailed statistical analyses 	<ul style="list-style-type: none"> Convenience sample of two separate samples: students & community Cross-sectional design Self-reported dietary status with no details Self-reported psychological outcomes; a single item 	<p>Low confidence in results:</p> <p>Meat abstainers and meat consumers did not differ on self-esteem levels.</p> <p>No evidence of a causal relation.</p>
<p>Kessler et al. (2018)</p> <p>Low rigor and high risk of bias</p>	<ul style="list-style-type: none"> WHOQOLA-BREF is well-established Detailed demographic information 	<ul style="list-style-type: none"> Cross-sectional design Extremely biased recruitment Limited, biased sample: medical professional attending plant-based conference High risk of misreporting due to the avoidance of cognitive dissonance and social desirability Self-reported dietary status Self-reported psychological outcomes 	<p>Very low confidence in results:</p> <p>No significant difference between meat abstainers and meat consumers on psychological well-being.</p> <p>No evidence of a causal relation.</p>
<p>Quick & Byrd-Bredbenner (2013)</p> <p>Very low rigor and severe risk of bias</p>	<ul style="list-style-type: none"> Large sample The RSES is well-established 	<ul style="list-style-type: none"> Limited, non-representative sample from three universities Cross-sectional design Self-reported dietary status Self-reported psychological outcomes 	<p>Very low confidence in results:</p> <p>Meat abstinence was associated with a lower level of self-esteem.</p> <p>No evidence of a causal relation.</p>

		<ul style="list-style-type: none"> • Abstract only; limited information on study details 	
<p>Beezhold & Johnston. (2012)</p> <p>Very low rigor and severe risk of bias</p>	<ul style="list-style-type: none"> • Randomized control trial • POMS-V is well-established • High self-reported diet compliance (> 95%) 	<ul style="list-style-type: none"> • Biased recruitment and sample • Small sample size per group • Lacked details on randomization • Study protocol may have induced observer-expectancy effects (e.g., reactivity, social desirability) • Statistically significant differences in mood subscale between groups at baseline • Mis-interpreted results: failure to recognize regression to the mean and floor effects 	<p>Very low confidence in results: No significant differences in vigor levels.</p>
<p>Aslanifar et al. (2014)</p> <p>Very low rigor and severe risk of bias</p>	<ul style="list-style-type: none"> • Groups matched on age & education level • Collected information on duration of meat abstinence 	<ul style="list-style-type: none"> • Variability in sampling strategies • Biased recruitment for meat abstainers • Cross-sectional design • Self-reported dietary status • Self-reported psychological outcomes • Proceeding conference paper 	<p>Very low confidence in results: Meat abstinence was associated with a higher level of happiness. No evidence of a causal relation.</p>

Note: FFQ = Food Frequency Questionnaire; IBD = Inflammatory Bowel Disease; The RSES = The Rosenberg Self-Esteem Scale; SF = short form; The POMS-V = The Profile of Mood States-Vigor; The PMH = The Positive Mental Health; WHO = World Health Organization; The WHOQOLA-BREF = The World Health Organization Quality of Life Assessment.