

Emotion regulation and healthy behaviors of the body energy balance in adults: A review of evidence

Andrés Gómez-Acosta; Constanza Londoño Pérez

How to cite this article:

Gómez-Acosta, A., & Londoño Pérez, C. (2020). Emotion regulation and healthy behaviors of the body energy balance in adults: A review of evidence. *Acta Colombiana de Psicología*, 23(1), 349-365. <http://www.doi.org/10.14718/ACP.2020.23.2.14>

Recibido, abril 26/2019; Concepto de evaluación, diciembre 13/2019; Aceptado abril 4/2020

Andrés Gómez-Acosta*

Universidad Católica de Colombia, Bogotá, Colombia
ORCID: <https://orcid.org/0000-0002-7932-0466>

Constanza Londoño Pérez

Universidad Católica de Colombia, Bogotá, Colombia
ORCID: <https://orcid.org/0000-0003-3273-3658>

Abstract

There is no document that analyzes the state of the art of scientific research published between 2013 and 2018 in relation to possible interdependence links between emotional regulation [ER] and healthy behaviors associated with Body Energy Balance [BEB] (physical activity, balanced diet and sleep hygiene). To achieve this purpose, an exploratory systematic review was conducted, whose search criteria were “emotion regulation”, “emotion dysregulation” connected with the Boolean operator “AND” to the keywords “sleep hygiene”, “eating behavior” and “physical activity”. Terms like “alexithymia”, “depression”, “stress”, “negative emotions”, and “rumination” were omitted. The methodological quality of the evidence was assessed with a patented rubric. After applying the analysis criteria, 35 articles were obtained, reporting the existence of reciprocal associations and interactions between ER and at least one of the three behaviors associated with BEB were analyzed. It is concluded that, despite the importance of these behaviors in the vital maintenance of people and the clear impact that emotional regulation has on them, their research has not been sufficient, and more empirical studies in this regard in Latin America are needed.

Keywords: Emotion Regulation (ER), Physical Activity (PA), Healthy Eating (HE), Sleep Hygiene (SH), Body Energy Balance (BEB).

Regulación emocional y conductas de balance energético corporal en adultos: Una revisión de evidencia

Resumen

No existe en la actualidad un documento que analice el estado del conocimiento de las investigaciones científicas publicadas en los últimos años con respecto a los posibles vínculos de interdependencia entre la regulación emocional (RE) y las conductas asociadas al balance energético corporal (BEC)—actividad física, alimentación balanceada e higiene del sueño—. Por tanto, para lograr dicho propósito, en el presente estudio se realizó una revisión sistemática exploratoria, cuyos criterios de búsqueda fueron los términos “emotion regulation” y “emotion dysregulation”, conectados con el operador booleano “AND” a las palabras clave “sleep hygiene”, “eating behavior” y “physical activity”—términos como “alexithymia”, “depression”, “stress”, “negative emotions”, y “rumination” fueron omitidos—; donde se valoró la calidad metodológica de la evidencia de los artículos a partir una rúbrica patentada. Tras aplicar los criterios de inclusión establecidos, se obtuvo un total de 35 artículos que reportaban la existencia de asociaciones e interacciones recíprocas entre la RE y al menos una de las

* Av. Caracas N. ° 46-40. Tel.: (+0571) 3277300, ext. 5071. clondono@ucatolica.edu.co

tres conductas asociadas al BEC. Como resultado, se puede afirmar que, a pesar de la importancia de dichas conductas en el mantenimiento vital de las personas y el claro impacto que tiene la regulación emocional sobre ellas, su estudio no ha sido suficiente, y por tanto se necesitan más investigaciones empíricas en el contexto latinoamericano.

Palabras clave: regulación emocional, actividad física, alimentación saludable, higiene del sueño, balance energético corporal.

Introduction

Living beings need to balance the caloric expenditure through an efficient recovery of body energy. Therefore, if the systems responsible for this balance fail, the body is induced to a progressive deterioration of increasing acceleration, which can make them more vulnerable to getting sick (López-Espinoza et al., 2014; Romieu et al., 2017). The World Health Organization -WHO (2010) states that leading a sedentary lifestyle, having an inappropriate diet and, sacrificing hours of sleep or of quality sleep, can significantly affect the cost-recovery equation and contribute to the development of chronic non-transmissible diseases (heart disease, cancer and diabetes, among others), which seriously affect the quality of life and can cause premature deaths (Lim et al., 2016).

Consequently, it is recommended the sustained realization of the behaviors associated with the Body Energy Balance (BEC), which are: a) Physical Activity (PA) understood as any movement produced by the contraction of musculoskeletal system that results in increase of caloric expenditure above baseline (Baker, Dobbins, Soares, Francis, Weightman, & Costello, 2015); b) Healthy Eating (HE), defined as the set of actions related to the consumption of balanced foods in response to motivations and availability of biological, psychosocial and contextual type (López-Espinoza et al., 2014); and c) Sleep Hygiene (SH) conceived as the rest that allows the efficient restoration of body tissues for proper functioning (Irish, Kline, Gunn, Buysse & Hall, 2014).

On the other hand, ER is defined as the way in which people manage the expression, suppression and intensity of emotions, based on both personal goals and the specific situations with which they interact at moment (Gross, 2014); the ER has been linked to the health-disease process in two ways: 1) by the influence of negative affective states (anger, anxiety and depression) on physiology, through psychoneuro-endocrine-immunological and epigenetic mechanisms, which contribute to the increase in allostatic load (Uskul & Horn, 2015), as well as to the imbalance of BEB and the concomitant development of systemic diseases (DeSteno, Gross, & Kubansky, 2013); and 2) through the optimal development of ER phases in the psychobiological and sociocultural domains that involve risk assessment, subjective experience of felt emotion, decision making (mediated by cognitive processes), and sustained performance of healthy

behaviors (like those of the BEB) that allow to minimize the risk, reduce the associated allostatic load and maximize the benefits (Gross, 2015; Waters, McQueen & Cameron, 2014).

People with RE problems report progressive deterioration of their quality of life and considerable decline in psychological well-being (Etchemendy et al., 2016), with occasional diagnoses of mental problems such as alexithymia, disruptive behavior, attention-hyperactivity deficit, generalized anxiety, depression, suicidal ideation, use of psychoactive substances and obsessive-compulsive personality disorders (González, Ramírez, Del Mar & Londoño, 2017; Sheppes, Suri & Groos, 2015). Similarly, some people believe that to counteract unpleasant moods they should include incentives and pleasant activities, but they encourage greater activation of hedonic schemes, procrastination and, ultimately, refer less effective skills for an adequate ER to possible temptations that compromise their health (Wagner & Heatherton, 2014).

On the contrary, those who learn to regulate their emotions in order to attenuate, maintain, amplify or change their behavior in accordance with the specific ecological and social objectives and context (Hoorelbeke, Koster, Demeyer, Loeys, & Vanderhasselt, 2016; Seligowski & Orcutt, 2015) are better adjusted to challenging daily events, and show better indicators in both physical health (Appleton & Kubzansky, 2014; Jenaabadi, Ali-Ahani, & Sabaghi, 2015) and mental health (Bonanno & Burton, 2014; Gross, 2015) than those who do not regulate their emotion (Etchemendy et al., 2016).

There are reviews aimed at identifying the available scientific evidence, carried out with the purpose of analyzing in depth the relationship between poor emotional regulation and the reporting of events in mental health in adults (Hu et al., 2015). However, although there are studies where ER is related to the development of healthy habits such as balanced diet, sleep hygiene and adequate physical activity of adults (Lee et al., 2016), there are no reviews regarding the way in which ER is linked to behaviors related to body energy regulation and that highlight the importance of this psychological process in the sustained execution of those behavioral aggregates that, in interaction, are responsible for the BEB.

For this reason, the aim of this systematic review was to determine the state of the scientific knowledge about the possible interdependence between emotional regulation

(ER) and behaviors associated with Body Energy Balance BEB (physical activity, balanced diet and sleep hygiene) in the adult population.

Method

Design

This research corresponds to a descriptive type documentary analysis carried out under the exploratory systematic review methodology, taking into account the criteria set forth by Manchado et al. (2009).

Documentary sample

The final documentary sample consisted of 35 research report articles identified with the inclusion criteria described below (see figure 1).

Inclusion criteria

The defined search terms were, "Emotion Regulation" or "Emotion Dysregulation" connected with the Boolean operator "AND" to the keywords "Sleep Hygiene", "Sleep" "Eating Behavior" and "Physical Activity". The only research considered were: a) experimental studies evaluating psychological

treatments aimed at optimizing ER to increase at least one of the behaviors associated with BEB; b) correlational studies aimed at identifying significant relationships between ER and at least one of the three behaviors associated with BEB; c) papers in which ER has been measured with an instrument validated specifically to account for this psychological variable and not for another such as self-control, affection, emotions, among other overlapping concepts.

Exclusion criteria

Conceptually overlapping terms were omitted in the search, but not homologous ones such as "alexithimia", "depression", "stress", "negative emotion", "emotional intelligence" and "rumination". Similarly, gray literature, theoretical articles, narrative reviews, letters to the editor and empirical works with other populations were not included.

Data collection and evaluation of the studies' methodological quality

The sample covered published or in press articles of scientific journals compiled by the databases Academic Search Complete, Virtual Health Library [VHL] of the Pan American Health Organization [PAHO], Embase, Medline, PlusONE, PsyArticles, PubMed, Redalyc and Science Direct, published from 2013 onwards.

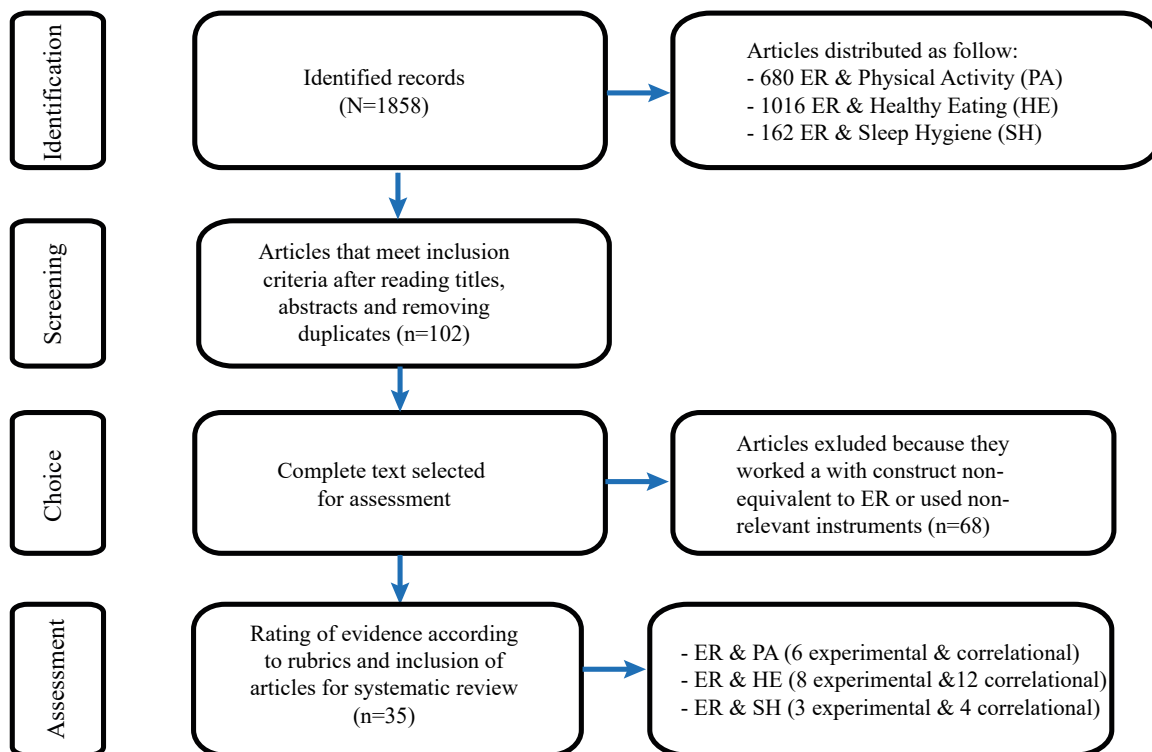


Figure 1. Flow chart of the articles' selection process. Source: prepared by the authors

The final sample was rated according to the "Instrument to assess the methodological quality of the articles selected for meta-analysis ®" designed, validated and patented by Gómez-Ortega & Amaya-Rey (2013, 2016), which proposes criteria for judging the methodological quality of scientific articles. This rubric evaluates the design, the sampling rigor, the instruments, collection and analysis of information, the presentation of results, and the discussion argumentation.

Ethical considerations

This review was carried out within the framework of a doctoral thesis approved by the ethics committee of the Universidad Católica de Colombia (Act 4, issued in October 2018); also, the referenced texts were consulted through access to freely accessible repositories and the databases subscribed with this university exclusively.

Results

The analysis of the documents that relate the RE with BEB behaviors (physical activity, healthy eating and sleep hygiene) is presented below. The table 1 maintains the same provision, in addition to an alphabetical order authors of the studies.

RE and Physical Activity

Regarding this item, eight articles were found, of which six were experimental and two was correlational. None of them indicates the effect size explicitly, although all detail the inclusion and exclusion criteria defined for the selection of the sample, describe the statistical procedures implemented for the analysis of the information, point to significant findings that answer the research question and verify the proposed hypothesis. Similarly, it is possible to identify in them consistency between the results, the conclusions and the limitations described.

However, two of them do not define conceptually and operationally the variables of interest; three of them (among which two experimental studies are included) do not mention a sufficient degree of control to allow establishing a high internal validity; three do not present the reliability/validity indicators of the measurement instruments implemented; one of the studies was not clear in describing the way in which the information was collected, and four do not report the procedure used to calculate the sample. As these studies were concentrated in only two English-speaking countries (the United States and the United Kingdom), one in Poland, and other in Taiwan.

Regarding the contribution of these documents to the scientific understanding, it was found that those who perform moderate aerobic exercise show more neuronal efficiency and cognitive control underlying ER (Hwang et al., 2018),

as well as greater ability to reinterpret negative emotional stimuli (Ligeza et al., 2019), without significant differences between those who perform moderate cardiovascular exercise and those who participate in stretching activity (Berstein & McNally, 2017).

Along the same lines, Wollenberg, Shriver and Gates (2015) found that high performance athletes have better positive reappraisal skills in relation to non-athletes, as well as greater satisfaction with their body image, self-esteem and lower risk of triggering any eating disorder. This same finding is confirmed by Wagstaff (2014), who shows that by subjecting three groups of athletes to situations that induce conditioned emotional suppression, the perception of physical exertion increases. On his part, Lane et al. (2015) found that, although ER intervention does not necessarily reduce pre-competitive anxiety, it may have some influence on better sports performance, which justifies the inclusion of ER training programs as part of the regular training of athletes.

Likewise, Giles et al. (2017) demonstrated that a successful cognitive re-evaluation is related not only to regular physical activity, but also to a greater oxygenation of the brain areas involved in ER. This contrasts with what was pointed out by Zhang et al. (2018), who related PA as an important factor for improving skills for implicit ER, and the recommendations of Strasser and Fuchs (2015), who associate PA as an important contention factor in the face of the potential damage induced by psychological stress, since it increases the modulation of norepinephrine, dopamine and serotonin, aspects which, in turn, have an impact on the improvement of cognitive processes and emotional regulation.

Due to conditions related to urban lifestyle, some people drastically reduce their levels of physical activity, which has an unfavorable effect in regulating emotions (Rofey, McMakin, Shaw, & Dahl, 2013). However, those people who exhibit higher levels of emotional expression and positive reappraisal manifest, in turn, a greater BMI control, higher rates of daily physical activity and better sleep hygiene (Shimanoë et al., 2015).

RE and Healthy Eating

In this category twenty articles were located, of which eight were experimental and twelve correlational. All of them present the conceptual and operational definitions of the case, describe the statistical procedures carried out for the analysis of the information, respond to the research question and hypothesis formulated, give an account of the correspondence between the reported results, the limitations found and the conclusions drawn. With only one exception, they present, both a detailed description of the steps followed to obtain the information, and the due indicators of reliability and validity of the tests used to measure the constructs.

Table 1.
Studies included in the systematic review (n=35). Source: Prepared by the authors

Researchers, year, country	Behavioral Family addressed	Characteristics of Participants	Type of study	Procedure	Rating according to rubrics (out of 20 points)	Conclusions
Berstein & McNally (2017) United States	PA	80 adults with regular practice of physical activity	Experimental	Application of a stretching program and a moderate aerobic exercise program.	14	Acute physical exercise and stretching can contribute to improve emotional regulation.
Giles et al. (2017) United States	PA	74 healthy participants	Experimental	Application of validated surveys and presentation of a negative stimulus to measure activation of the prefrontal cortex through the use of functional Neuro-imaging.	17	There is a positive correlation between scores of successful ER, greater oxygenation of the prefrontal cortex and the practice of regular exercise.
Hwang, Chen, Guo, Lee & Liu (2018) Taiwan	PA	30 women with affective disorders	Experimental	EEG measurement (pre & post to go/no-go task with sad stimuli) were developed to a moderate PA above a standard treadmill	17	PA may contribute to greater neural efficiency in executive control underlying the regulation of sadness
Lane et al. (2015) United Kingdom	PA	15 elite athletes	Experimental	ER intervention to regulate unpleasant emotions and increase the pleasurable emotions associated with their sports performance.	12	Training in ER strategies is suggested under controlled conditions to generate positive emotions as part of regular training.
Ligeza, Kalamala, Tarnawczyk, Maciejczyk & Wyczesany (2019) Polonia	AF	26 athletes and 26 sedentary people	Correlational with laboratory measures	Training in reinterpretation of negative emotional stimuli, evaluation of an experimental task with a psychophysiological record, and comparison of the performance of the groups	18	Sustained PA is associated with a greater ability to reinterpret negative emotional stimuli, although this is more evident in psychophysiological than behavioral indicators
Wagstaff, (2014) United Kingdom	PA	10 sports-women and 10 sportsmen (8 runners, 6 swimmers and 6 rowers).	Experimental	Presentation of a situation that induces a basic emotion, with the instruction to suppress it (a), not suppress it (b), or not be exposed to it (control). In addition, they resolved pre and post Stroop to a situation of PA.	19	People with ES had more errors in the Stroop post-test, increased perception of effort, reduced blood glucose and had lower sports performance.
Wollenberg, Shriver & Gates (2015) United States	PA	540 female (121 athletes and 376 non-athletes)	Correlational	Self-reporting instruments are applied. The EmD and the tendency to have ED between the two groups are compared.	13	Non-athletic females showed higher rates of ED and greater difficulty with their ER.

Researchers, year, country	Behavioral Family addressed	Characteristics of Participants	Type of study	Procedure	Rating according to rubrics (out of 20 points)	Conclusions
Zhang, Fu, Sun, Gong & Tang (2019) China	PA	29 people (experimental group) and 31 participants (waiting list)	Experimental	Eight sessions combining meditation, yoga and aerobic jogging were developed, and the variables ER, aerobic exercise and mindfulness are evaluated	18	Despite being a short intervention, the implemented protocol improved the skills of implicit ER
Agüera et al., (2019) Spain	HE	62 men and 656 women with ED, compared with 286 women and 78 healthy men	Correlational	Self-reporting instruments are applied (ED, mental health symptoms, personality and ER).	12	ER is reciprocally related to less presence of psychopathology, personality troubles or eating disorders. However, the treatment of ER must be differential in terms of gender.
Brockmeyer et al., (2014). Germany	HE	6 groups of women	Correlational	Self-reporting instruments are applied to 35 women with restrictive AN, 22 with AN and purge, 34 with BN, 29 with binge, 60 controls without overweight and 29 controls with overweight.	12	There are significant differences in all dimensions of ED between patients diagnosed and control groups. In that order, there is lower ER and it is related to ED.
Crocket, Myhre & Rokke (2015) United States	HE	553 university students	Correlational	Convenience sampling, online self-reporting instruments completed.	11	Difficulties in ER and boredom predict emotional eating.
Echeverri-Alvarado, Pickett & Gildner (2020) United States	HE	360 participants with post-traumatic stress disorder	Correlational	Random sampling was obtained through the Mturk platform. Participants solved an online form with the instruments	14	Binge eating in people with post-traumatic stress disorders is partially explained by emotional eating and emotional dysregulation
Eichen et al. (2017). United States	HE	40 compulsive eaters and 47 controls	Experimental	ER facing stressful stimuli and the resolution of them was measured through a computer program.	17	People with binge eating are more irritable and impulsive with respect to their counterpart.
Ferrell, Watford & Braden (2020) United States	HE	77 university students	Correlational	Bioanthropometric and sociodemographic information, as well as ED, ER and working memory measure are evaluated with self-reporting	13	Difficulties in ER and working memory are predictors of emotional feeding in boredom situations

Researchers, year, country	Behavioral Family addressed	Characteristics of Participants	Type of study	Procedure	Rating according to rubrics (out of 20 points)	Conclusions
Ferrer, Green, Oh, Hennessy & Dwyer (2017) United States	HE	1556 parent-adolescent dyads (3112 participants)	Correlational	BMI was measured, and ethnicity, marital status, gender and educational level were searched with self-reporting, completed online.	13	ES is positively correlated with high consumption of "hedonic" food and low consumption of fruits and vegetables, both in parents and their children.
Giuliani, Calcott & Berkman (2013) United States	HE	82 university students	Experimental	Training in cognitive re-appraisal before appetitive stimuli responsible for craving towards food.	15	Cognitive re-appraisal is successful in reducing the desire to consume high-calorie foods.
Hayaki & Free, (2016) United States	HE	121 women and 80 men	Correlational	The population with ED was filtered by means of an instrument without a confirmed diagnosis.	11	The lack of ER in conjunction with the expectations of pleasure and food reward can predict higher risk to develop ED, although more in women.
Haynos, Hil & Fruzzetti (2016) United States	HE	72 obese women with restriction diet, 36 with ER, and 36 with nutrition.	Experimental	Virtual training in ER with DBT compared to nutrition training.	20	Brief training in ER is as effective as the nutritional dietary restriction program.
Herhaus, Ullmann, Chrousos & Petrowski (2020) Germany	HE	36 obese people and 36 healthy controls	Correlational with experimental measures	The groups underwent two situations (stress and recovery), and the subsequent food intake are measured with a standardized protocol; in addition, successive measurements of cortisol, stress and RE were made	17	Low cognitive reevaluation and high reactivity to cortisol in stressful situations are indicators associated with a higher intake in obese patients, but not in controls
Holmqvist et al. (2020). Sweden	HE	29 participants with ED	Experimental	Training in ER with five group sessions (one weekly – duration two hours) from DBT and ACT	16	ER skills training complements eating disorders treatments and to stabilize associated behavioral responses

Researchers, year, country	Behavioral Family addressed	Characteristics of Participants	Type of study	Procedure	Rating according to rubrics (out of 20 points)	Conclusions
Juarascio et al. (2020). United States	HE	76 adults who in the last month had four or more binge eating	Experimental	The impact of three variants of treatment on emotion focused (emotional awareness, negative ER & distress tolerance) are evaluated.	18	All three therapeutic forms are helpful in reducing emotional eating, but each component addressed demonstrates a unique mechanism of action
Kukkk & Akkermann (2019) Estonia	HE	104 men with binge eating and need for food restriction	Correlational	Ecological evaluation to discriminate participant data, calculation of BMI, and subsequent application of self-report instruments in ED and ER	12	ER difficulties and needs for food restriction mediate negative affect and control capacity in binge eating
Maciel, Shuster de Souza, Araujo, de Lara & da Silva (2017) Brazil	HE	14 participants (experimental group) and 17 healthy people	Experimental	Training with DBT during 10 weekly sessions. Five of the scheduled sessions focused on strengthening ER	18	The results support that this therapeutic approach contributes to reduce distress and improve adaptative feeding in obese
Meule et al. (2019) Germany & Austria	HE	54 women with anorexia nervosa, 47 with bulimia and 68 healthy	Correlational	Self-reporting instruments are applied to investigate their levels of ED, depression, ER, and Emotional Eating	12	ER is compromised in patients with anorexia nervosa and bulimia, even when patients report opposite eating patterns
Meyer & Leppma (2018) United States	HE	100 people, 10 of them with an ED and seven with related treatment	Correlational	Participation involved the diligence of instruments of awareness, self-compassion, difficulties in ER, and attitudes towards food, as well as sociodemographic information	12	Low awareness and lack of self-compassion are predictors of ER difficulties. This, in turn, becomes a risk factor for the development of ED
Rodríguez, Gempeler, Mayor, Patiño, Lozano & Pérez (2017) Colombia	HE	19 women with anorexia, 22 with bulimia and 2 with binge eating	Experimental	An intervention is carried out with multimodal DBT. For this study, only the information from the session aimed at the modification of emotional situations are taken	13	The DBT session is helpful for the improve the RE associated with dysfunctional eating behaviors
Shriver, Woltenberg, & Gates (2016) United States	HE	151 female athletes, 87 with high tendency to gain weight and 64 with low sensitivity	Correlational	Convenience sampling, cross-sectional study, self-reporting instruments.	9	Low ER correlates with ED, body dissatisfaction, worry about weight, binge eating and compensatory beliefs in both groups.

Researchers, year, country	Behavioral Family addressed	Characteristics of Participants	Type of study	Procedure	Rating according to rubrics (out of 20 points)	Conclusions
Wattford, Braden & Embley (2019) United States	HE	189 adults with overweight or obese	Correlational	Online questionnaires are applied to inquire about BMI, psychological treatments, mindfulness, ER, symptoms in mental health, appetite and emotional eating	15	Optimal indicators of mindfulness and low emotional eating (particularly in negative emotions) may be associated with high levels of ER and subjective wellbeing
Ellis, Prather, Grenne & Ferrer (2019) United States & United Kingdom	SH	1255 healthy people	Correlational	Data recording about sleep quality, ES, PR, stress perception and allostatic load biomarkers	15	ES is a predictor of poor sleep quality, and both (together) of increase allostatic load
Mauss, Troy, & LeBourgeois (2013). United States	SH	156 people	Experimental	Short videos presentation inducing sadness in the laboratory, and self-report completion of corresponding cognitive re-appraisal.	13	There was a positive correlation between poor sleep quality and poor re-appraisal of negative emotions.
O'Leary, Bylsma, & Rotenberg (2016) United States	SH	Moment 1: 143 people with depression. Moment 2: 95 people	Correlational	Moment 1: Baseline is taken. Moment 2: Three sadness-inducing videos are watched to measure cognitive re-appraisal, contrasting clinical measures.	12	ER mediates the relationship between poor sleep quality and manifestation of depressive symptoms. PA does not mediate between sleep quality and mood.
Sandru & Voinescu (2014), Romania	SH	133 adults	Correlational	It was inquired online (EmD, sleep index and beliefs about sleep); sampling was at convenience.	10	Except in the dimension of consciousness, all dimensions of difficulties in ER are associated with poor sleep quality.
Semplonius & Willoughby (2018) Canada	HS & PA	827 university students	Correlational	For three years, participants are measured for ER difficulties, sleep quality and PA through self-reporting.	11	Good quality sleep predicted high ER, and this, in turn, predicted a moderate to high PA levels. Both healthy behaviors predict ER in the long term.

Researchers, year, country	Behavioral Family addressed	Characteristics of Participants	Type of study	Procedure	Rating according to rubrics (out of 20 points)	Conclusions
Vantighem, Marcoen, Mairesse & Vandekerckhove (2016). Belgium	SH	1291 people	Correlational	Participants were classified according to their sleep hygiene, personality traits and ER trends (ES or PR). Variables are controlled such as stress perception, caffeine consumption, alcohol and cigarette, as well as BMI. A conflictive situation was induced and food consumption with saturated fat, alcohol, caffeine, dietary supplements and no physical activity was recorded two days before being in the laboratory. At the same time, ER was measured as a mediator of conflict resolution.	11	ES correlates negatively with high quality sleep, while reappraisal correlates positively, although the relationship between ER and personality is not clear.
Wilson et al. (2017) United States	SH	43 healthy heterosexual couples with marital problems	Experimental		16	Couples who slept less, but with positive RE strategies to resolve their conflicts manifested lower amounts of IL-6 and TNF.

Conventions: PA = Physical Activity; AN = Anorexia Nervosa; HE = Healthy Eating; BN; Bulimia Nervosa; EmD = Emotional dysregulation; EE = Emotional Expression; TNF = Tumor Necrosis Factor; SH = Sleep Hygiene; IL-6 = Interleukins 6; BMI = Body Mass Index; ER = Emotional Regulation; PR = Positive Reevaluation; ES = Emotional Suppression; ED = Eating Disorder; DBT = Dialectical – Behavioral Therapy; ACT = Acceptance & Commitment Therapy.

Despite this, only half of the studies report the inclusion/exclusion criteria determined for sampling and 10 of them do not present a high internal validity since they do not offer a high degree of variable control (within which there is one experimental study). Only four study accounts for the way the calculation of the sample was carried out, and none explicitly indicates any effect size coefficient. These studies were conducted in the United States (12), Germany (three), Spain (one), Sweden (one), Estonia (one), Brazil (one), Austria (one), and Colombia (one); so a drastic effect be expected given the cultural differences of both countries in the ER measurement.

Participants were found who decide to avoid or reduce negative emotions by means of compulsive eating, which was evidenced from self-reported measurement (Echeverri-Alvarado et al., 2020; Kukk & Akkermann, 2019), and laboratory controlled records (Eichen et al., 2017; Herhaus et al., 2020). This coping strategy is a mechanism learned and reinforced during the psychological development of individuals that correlates with boredom (Crocket et al., 2015; Ferrell et al., 2020) and with emotional suppression (Harrist, Laura, Topham, Shriver & Page, 2013).

It was also found that people with restrictive anorexia, purged anorexia, and bulimia nervosa present greater difficulties in their ER in the dimensions of non-acceptance of the situation, few behaviors directed towards adaptative goals, impulsiveness, few management strategies, lack of awareness of their emotions and emotional clarity (Brockmeyer et al., 2014), as well as lower levels of full awareness and self-compassion (Meyer & Leppma, 2018; Watford et al., 2019), despite the fact that these patients show diverse eating behaviors (Meule et al., 2019). These same problems are correlated with dissatisfaction with body shape and weight, binge-eating tendencies and development of compensatory beliefs, particularly concerning food and physical exercise (Shriver et al., 2016).

On the other hand, Ferrer et al. (2017) highlight that emotional suppression in stressful conditions has a direct effect on both the preference for high-calorie foods (called "hedonic foods") on the part of adults and their adolescent children. However, it is identified that, when comparing by sex, the presence of difficulties in ER correlates with the subjective value given to food as a reinforcer, so that women, when faced with overwhelming situations, would have a greater tendency to choose emotional eating as a way of coping (Hayaki & Free, 2016); this event is associated with the need to propose differential preventive and therapeutic approaches based on the gender (Agüera et al., 2019).

In response to the above, it is necessary that training in positive reevaluation (Giuliani et al., 2013) and particularly

those developed under third-generation models such as dialectical behavioral therapy (DBT), could contribute to the management of the difficulties in ER that precede behaviors such as food restriction and compulsive eating (Holmqvist et al., 2020; Juarascio et al., 2020; Maciel et al., 2017; Rodríguez et al., 2017). People can select a situation to avoid contact with foods that trigger the compulsive response, eat substitute foods, guide their attention towards foods with lower caloric value, re-evaluate the intake depending on their consequences and modulate the consumption response to contribute to the systematic reduction of anxiety. In this way, they can achieve specific objectives such as lowering the BMI or cholesterol levels (Giuliani & Berkman, 2015). Likewise, people can increase their self-efficacy regarding healthy behaviors associated with both good nutrition and reduction of sedentary lifestyle (Isasi, Ostrovsky & Wills, 2013).

RE and Sleep Hygiene

Regarding the relationship between ER and sleep hygiene, seven articles were obtained, corresponding to three experimental investigations and four correlational studies. All of them give an account of the information collection process, describe the statistical procedures implemented for data analysis, report results that answer the research question and hypothesis, and it is possible to identify that they are consistent with the obtained figures, the inferences made and the limitations exposed.

However, one of them does not define conceptually and operationally the variables of interest; four of them do not account for a sufficient degree of control that allows to conclude the presence of a high internal validity (including the two experimental studies); two of them do not present the reliability/validity indicators of the measurement instruments implemented, while two others did not describe the corresponding inclusion / exclusion criteria, and none report neither the procedure used for the calculation of the sample, nor an indicator of the effect size. These studies were conducted in the United States (three), Romania (one), United Kingdom (one), Canada (one) and Belgium (one), so differences in ER understanding and measurement can be more biased by cultural differences, which makes it difficult (in principle, although it is not the rule) the comparison between them.

On the other hand, documented evidence highlights that people who are exposed to stimuli with strong emotional content, but who also refer poor sleep quality, may present more symptoms associated with a negative mood and poor positive reappraisal skills (Mauss et al., 2013), which is further corroborated with the increase in emotional

dysregulation indicators (O'Learly et al., 2016), that can even affect the PA realization (Semplonius & Willoughby, 2018). Along this line, Sandru and Voinescu (2014) identified that people who have a poor quality sleep have a harder time accepting situations, manifest few adaptive behavior management strategies, show greater impulsivity/irritability, and report lack of emotional clarity, high levels of catastrophization, a perception of emotional dysregulation, as well as problems of attention, concentration, memory and executive functions which, in turn, can generate less positive emotions and fewer optimistic reasoning (Sandru & Voinescu, 2014).

Likewise, Vantieghem et al. (2016) report that those who show the greatest amount of suppression as an emotional regulation strategy have a lower sleep quality, even when this situation is not directly related to any specific personality trait. However, this situation (sleep deprivation), although it may eventually affect the future ER, does not necessarily compromise an adequate conflict resolution, as long as a previous training in positive reappraisal takes place (Wilson et al., 2017).

When contrasting with other references it is evident that sleep problems can be precursors of the lack of emotional regulation due to insufficient capacity to restore the nervous and endocrine systems (Irish et al., 2014), and to influence areas such as the medial prefrontal cortex, the anterior cingulate cortex, the amygdale, and the striate cortex (Palmer & Alfano, 2017). This can affect emotional reactivity, impulse regulatory control, sensitivity to punishment, perception of rewards, and motivational salience towards the achievement of certain objectives (Fairholme & Manber, 2015). It may also lead to not very successful ER strategies (Palmer & Alfano, 2017), with a significant impact on BMI increase (Rofey et al., 2013), and in the growth of the allostatic load (Ellis et al., 2019). However, it has also been reported that not necessarily the emotions experienced in the course of the day predict the quality of sleep the following night (Simor, Krietsch, Koteles & McCrae, 2015), so more research is suggested with respect to such interactions.

Discussion

Despite the ER potential as a set of processes related to the BEB behavioral aggregates, there are few studies that explicitly address this psychological process with observations and controlled measurements of the identified interactions. There are even fewer studies that explicitly refer to the effect size, which makes it impossible both to

compare whether ER presents homogeneous effects on the families of the behaviors addressed, and demonstrate the possible heterogeneity of the subsets of the revised variables (Sánchez-Meca & Botella, 2010). Taking into account that 17 of the studies examined do not correspond to research with experimental measurements, it is suggested to develop more studies that enable demonstrate both in controlled environments (with observation, recording and analysis of biomarkers), and in real human contexts (with population- based and longitudinal studies) the effective interdependence that theoretically exist between RE and BEB behaviors.

Likewise, it is desirable that future research ensure characteristics such as: including sufficient conceptual and operational definitions of variables; demonstrate an optimal degree of control that allows internal validity to be assured; present the validity and reliability indicators of the corresponding instruments; describe the defined inclusion, exclusion and sampling criteria; give an account of the steps developed for data collection and analysis; report results that strictly respond to the research questions and hypotheses formulated, and explicitly identify both the limitations and new possibilities of the studies. All this in order to contribute with research of high methodological quality that, in turn, can provide more conclusive evidence regarding the relationship between ER and the behavioral aggregates addressed.

Regarding the contributions, although in this document it has been stated that there is more empirical evidence in favor of the preponderance that cognitive reappraisal would have versus emotional suppression as a strategy to achieve an adequate ER, authors such as Luong, Wrzos, Wagner and Riediger (2016) suggest that the inappropriate and unpleasant connotation of emotional suppression should be reexamined in light of the meanings given to emotions in each culture, which, in turn, could have some interference in the practice of any of the three behavioral aggregates. To give an example, according to Hu et al. (2014), emotional suppression reactions in Eastern cultures are not necessarily linked to the development of somatic illness symptoms (which have the potential to become factors for initiating healthy practices), as it is more likely to happen to those who are part of the western culture. To that extent, authors such as Kashdan, Young y Machell, (2015) postulate that emotional suppression can also be adaptive, to the extent that it allows a better adjustment to personal expectations and competences, and in this way, contribute to a positive state of health, for example, when people set for themselves goals as the reduction of weight through physical exercise.

Similarly, it is found that in several of the studies described, the strategies of emotional regulation are assumed to

be monolithic, not susceptible of being modified according to the contextual conditions in which the person functions (Dore, Silvers & Ochsner, 2016), their current emotional goals (Dixon-Gordon, Aldao & De los Reyes, 2015; Kashdan et al., 2015), differences in personality style (Vantieghem et al., 2016), cultural valuations and differences in prevalence and health incidents in the regions (Hu et al., 2014). Given this situation, it would be convenient to include more holistic conceptual variants such as the proposal of flexibility in emotional regulation (Aldao, Sheppes & Gross, 2015) as a co-determining factor of BEB behaviors.

It is also relevant that the positive repercussions of sleep quality, moderate physical activity or balanced diet are related to a sustained practice over long periods of time, whereas ER strategies are assessed according to the immediate context (Mauss et al., 2013). This would pose some difficulty to research, since there would be two types of practices (BEB on the one hand and RE on the other) which are not necessarily synchronized in terms of their evolution and manifestation. In this regard, as ER strategies are more fluctuating and dependent on specific circumstances, it becomes a challenge for health and behavioral sciences to account for the interdependence relationships of two equally important dimensions in reducing stress levels manifested by people (Myers et al., 2012) and for attaining a greater well-being, quality of life and general health (Gross, 2015).

Everything mentioned up to this point implies that, in order to understand the complexity that this relationship poses, further studies must account for associations between positive / negative affect and cognitive - social processes that are related to ER, such as optimism - pessimism (Jenaabadi et al., 2015), or compensatory health beliefs (Shriver et al., 2016), within the framework of an integrating model that should specify the conditions established by the physical and sociocultural context under which these ER strategies operate, depending on their possible repercussion in the three behavioral aggregates related to BEB.

Although the objective of this study was not to directly evaluate the work related to the interaction between ER processes and BEB behaviors, the reflection on the findings does allow generating new investigations in which ER is manipulated and the effect size is contrasted for the increase of health self-care behaviors (Gómez-Acosta, 2017). This may enable the provision of evidence regarding the ER relationship, the increase in BEB behaviors and adherence to treatment/ reduction of health situations such as morbid obesity, eating disorders, cardiovascular diseases, diabetes mellitus, insomnia and other chronic non-communicable diseases (Gómez-Acosta, 2018).

On the other hand, the development of new predictive and explanatory models should be promoted, allowing not only a better understanding of the confluence of intervening factors in the ER relationship and the sustained practice of adult BEB behaviors (including cognitive and contextual factors), but that also seek the strengthening of cognitive reappraisal and positive emotions for the reduction of adverse events and improvement of habits that positively impact on health (Cerolini, Balleisio & Lombardo, 2015; Gross, 2015).

The following is the list of limitations of the present review. In the first place, no studies were found in Spanish that related ER to BEB behaviors that fully met the defined criteria, which reduces the possibilities of generalization of this analysis to the Spanish-speaking population, so it would be essential to encourage the development of research projects in this regard in Latin America. Second, although there are studies that report having investigated ER, it is found that what is actually tackled are constructs such as positive / negative mood, coping, stress, depression, rumination, alexithymia, and emotional lability, among others, which is associated with difficulties in the delimitation of the concept, in coherence with what Palmer and Alfano stipulated (2017). Third, and in addition to the above, different instruments were used to measure ER (Difficulties in Emotion Regulation Questionnaire [DERS], Cognitive Emotion Regulation Questionnaire [CERQ], Emotion Regulation Questionnaire [ERQ]), which allows obtaining ER dimensions and different metrics that make comparisons between studies difficult. Finally, it is reported that the article subscribes a publication bias, by selecting only articles from high impact indexed journals, to the detriment of the inclusion of documents compiled by institutional repositories.

It can be concluded that, in effect, ER has an impact on the physical health of people, and is not only directly linked to the processes of psycho-neuro-endocrine-immune homeostasis and associated epigenetic correlates, but can also indirectly affect this balance through the interaction that RE holds with the behaviors associated with BEB. In this case, it is convenient to develop more research that will allow, on the one hand, have a better understanding of the reciprocal functioning of these systems and their spiraling feedback, and on the other hand, that will lead to a better understanding of the relationships between ER and other psychological factors underlying health protective practices (Ellis et al., 2019; Gómez-Acosta, 2018).

Conflict of interest

The authors declare they have no conflicts of interests.

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