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INTEGRATIVE REVIEW

Health Risk Behaviors and Self-Esteem Among College Students: Systematic Review of Quantitative Studies

Julie Arsandaux [1] · Ilaria Montagni [1] · Melissa Macalli [1] · Vincent Bouteloup [2,3] · Christophe Tzourio [1] · Cédric Galéra [1,4]

Abstract

Background Due to their impact on premature mortality and long-term disabilities, a better understanding of health risk behavior (HRB) determinants among college students is crucial in order to build the most appropriate prevention tools. Although self-esteem appears to be a relevant candidate, a clear picture summarizing its multiple links with HRB is lacking to guide clinicians and researchers. This study aims to provide a systematic review of the associations between health risk behavior and self-esteem among college students.

Methods This search was performed in several databases on 02/02/17. Study eligibility criteria were original articles in peer-reviewed journals, in English; observational quantitative studies; among college students; and investigated the association between self-esteem and HRB. The PRISMA statements were complied with.

Results One hundred fifteen articles were included: 46 on substance use, 35 on sexual behavior, 11 on nutritional habits, 27 on physical activity, and 5 on other HRB. Most studies reported an association between higher self-esteem and healthier behavior. For alcohol consumption and number of sexual partners, both negative and positive associations have been reported. Directionality was investigated in a few studies suggesting potential bidirectional effects.

Conclusions This review points out the need for consensus for the definition of self-esteem and HRB. There was high heterogeneity in (1) the measurement of self-esteem either in the concept measured (global vs. domain) or in the way to implement validated tools; and (2) the definition of HRB. Self-esteem seems to be a relevant target to intervene on HRB, especially alcohol abuse and physical activity.

Trial Registration Registration number: PROSPERO (ID = CRD42017056599).

Keywords Self-esteem · Health risk behavior · Students · Systematic review

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Introduction

The contribution of health risk behavior (HRB) to physical and mental health is substantiated by an extensive body of evidence [1–3]. Quantitatively, unhealthy behaviors (including smoking, alcohol, inadequate physical activity, and unhealthy nutrition habits) have been found to be associated with a fourfold increase in total mortality in men and women in the general adult population [1].

The definition of HRB is not homogeneous. According to the World Health Organization (WHO), HRB are defined as behaviors that affect health both at the present time and in later years [4]. The Centre of Disease Control (CDC) defines HRB as behaviors which have been found to affect the health of individuals negatively and dramatically. Through the development of the Youth Risk Behavior Surveillance System (YRBSS), the CDC proposes a taxonomy which classifies

HRB as follows [5]: (1) behaviors that contribute to unintentional injuries and violence [6, 7]; (2) sexual behaviors related to unintended pregnancy and sexually transmitted infections (including HIV) [8–10]; (3) alcohol and other drug use [11, 12]; (4) tobacco use [2, 13]; (5) unhealthy dietary behaviors [14–16]; and (6) inadequate physical activity [17, 18].

Because of their impact on premature mortality and long-term disabilities, unhealthy behaviors have become the focus of prevention actions driven by public health policies [19, 20]. A better understanding of the determinants of HRB is therefore crucial to inform and build the most appropriate prevention tools. Psychological factors, especially self-esteem can play an important role in HRB [21]. Several studies have evidenced associations between self-esteem and a number of important outcomes related with health: academic success, well-being, and internalized/externalized mental health problems [22–25]. A large number of studies have investigated links between self-esteem and HRB that are of interest for this study. Beyond the statistical correlation between self-esteem and HRB, the links between these dimensions are theoretically bidirectional (i.e., levels of self-esteem could impact development of HRB and HRB could lead to changing levels of self-esteem) [22]. There is no consensus on a single definition of self-esteem and two main categories coexist: global self-esteem and dimensional self-esteem. For the former, the most widely used definition is from Rosenberg (1965): the individual's positive or negative attitude toward the self as a totality [26]. The Rosenberg Self-Esteem Scale (RSE) is the most validated and reliable tool for its measurement. Several dimensional self-esteem measurements are available depending on the dimension of interest (e.g., social, physical, decisional self-esteem) [27]. Another distinction is between explicit (corresponding to global self-esteem as measured by the RSE scale) and implicit self-esteem (which can be measured with specific scales) [28].

While HRB and self-esteem development start from childhood and go on interacting throughout life, young adulthood appears to be a key period for a better understanding of the association between HRB and self-esteem [21, 29, 30]. First, this period corresponding to the transition between adolescence and adulthood is crucial to the development of individuals, as well as in constructing and reinforcing self-esteem [31]. Although the student population is in relatively good health, it is noteworthy that mental health (e.g., anxiety and depression) and substance use issues are prevalent during the college years [32–35]. Consequently, determining [1] the specific role of self-esteem in the development of HRB and [2] the impact of HRB on self-esteem is relevant during this period of life. On the one hand, self-esteem could represent a target for preventing or identifying a population that is vulnerable to the development of HRB. On the other hand, deleterious HRB could impact self-esteem, which in turn could impact health and academic success.

Despite a large body of research on self-esteem and HRB, we could not find any systematic review investigating the specific associations between self-esteem and HRB. A synthesis of evidence in this topic area is not easy. First, there is a disciplinary heterogeneity in the field that hampers an easy overview since articles have been published in different types of journals according to the HRB of interest. Second, self-esteem has often been overlooked, as it is seldom a primary objective in prior research, despite its obvious relationship with HRB. A systematic review methodology is necessary to find all the studies that have explored the association between self-esteem and HRB, whatever the type of journal or primary objective of the study. Throughout this systematic review, we have summarized the state of knowledge about the association between self-esteem and HRB with a particular interest in reporting the level of evidence, identifying gaps in the existing literature, and highlighting areas where further research is needed.

The aim of this work was to provide a systematic review of the associations between HRB and self-esteem among college students by reporting and discussing the level of evidence of the association (correlation, strength, and directionality).

Methods

Protocol and Registration

The methods of the analysis and inclusion criteria were specified in advance and registered on PROSPERO (ID = CRD42017056599). This systematic review conforms to the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [36] .

Eligibility Criteria

We included original articles in peer-reviewed journals in English. Studies were included if observational quantitative research methods were used. Participants attending a college/university course, of all years of study and all ages were included. As there is no consensus on the definition of self-esteem, we included studies mentioning the term "self-esteem." We used the classification of the Center of Disease Control and Prevention (CDC) and the Youth Risk Behavior Surveillance System (YRBSS) for defining HRB. Other HRB were included in the review if they matched the abovementioned WHO definition. Both specific and general HRB (i.e., a combination of different behaviors) were included. We were interested in behaviors that can lead to damage to health; we excluded studies estimating the association between self-esteem and pathological behaviors that corresponded to health outcomes rather than to health behaviors: suicide attempts or suicide and eating disorders

(anorexia, bulimia). We selected studies examining the association between self-esteem and HRB through primary and secondary analysis.

In addition to a complete qualitative synthesis, we selected a subgroup of articles that were more homogeneous to perform a quantitative synthesis (see supplemental material A for details).

Information Sources

Studies were identified by searching electronic databases and scanning reference lists of articles. This search was performed in PubMed/Medline, PsycINFO, Scopus, and Web of Science. A limited literature update search was performed from 2 February 2017 to 31 July 2018 (i.e., search with the same algorithm on all databases and check for eligibility by a single person (JA)).

Search Strategy

We used MeSH (Medical Subject Headings) to determine the search terms. These terms were entered into all the databases described above: self-concept, self-esteem, students, universities, college, risk taking, dangerous behavior, unsafe sex, sexually transmitted diseases, sexual behavior, alcohol drinking, marijuana smoking, tobacco use, drug users, feeding behavior, diet food and nutrition, diet, sedentary lifestyle, exercise, sports, accidents, automobile driving. Full algorithms are available in supplemental material B.

Study Selection

Eligibility assessment was performed independently in an unblinded standardized manner by two reviewers (JA and IM). Disagreements between reviewers were resolved by consensus after discussion with the project team (JA, IM, CT and CG). When more than one study was reported in a single paper, we checked each study for eligibility according to the eligibility criteria describe earlier.

Data Collection Process and Risk of Bias Assessment

Extraction of data from articles was performed using predefined data fields created for the review. The four collected items composing the extraction sheet were (1) identification of the article or study selected and the HRB under study; (2) study description: including study design, objectives, eligibility criteria, sample size, self-esteem, and HRB measurement methods plus the conceptual framework or theory basis used for the defined research hypothesis (if defined); (3) main characteristics of the population including sex, age, university year, ethnicity, completion of follow-up if longitudinal study, self-esteem estimation (by sex if provided), and HRB

frequency (only behavior tested with self-esteem); and (4) estimation of the association between self-esteem and HRB (point estimate, confidence interval, and level of statistical significance). Information about statistical methods and adjustments concerning this association was also recorded. The data extraction sheet also included study quality indicators. We used the Item Bank for Assessment of Risk of Bias and Precision for Observational Studies of Interventions or Exposures for assessing the risk of bias [37]. Two epidemiologists (JA and MM) pilot-tested it on 13 randomly selected included studies, and obtained a good percentage of agreement: 92% for all items, 97% for study characteristics, and 89% for the risk of bias evaluation. Disagreements were discussed between the co-authors, leading to an update of the extraction sheet (i.e., clarifying instructions, adding specific comments according to the review domain, and simplifying the risk of bias sheet). See supplemental material C for the original data form. Then, one reviewer (JA) extracted the data from the included studies. A quality check of ten (randomly selected) studies revealed an improvement, with these modifications leading to 95% agreement (94% for study characteristics and 95% for the risk of bias evaluation).

Summary Measures

The primary outcome was an estimation of the association between levels of self-esteem and the presence or frequency of an HRB, including the strength, directionality of the association, and level of statistical significance. Effect sizes were unstandardized across the studies due to considerable heterogeneity between measures and statistical methods and a lack of reporting for several studies. We extracted the estimate of the effect size (based on its absolute value, its confidence interval) and reported the strength of the association qualitatively. We defined the strength of the association depending on the type of estimates reported across the studies (i.e., correlation coefficient, regression coefficient, or odds ratio). For the correlation coefficient, we used Cohen's (1988) conventions to interpret effect size: weak if 0.20, moderate if 0.50, and strong if 0.80. For the regression coefficient and odds ratio, judgment of strength was based on the scale used for measuring self-esteem and health risk behavior and the choice of statistical methods. A positive association was defined as higher self-esteem associated with the presence or higher frequency of unhealthy behavior, whereas a negative association was defined as higher self-esteem associated with the absence or lower frequency of unhealthy behavior. The directionality of the association was described if at least one study was designed to provide such information (i.e., longitudinal design).

Synthesis of Results/Planned Methods of Analysis

A qualitative synthesis was performed. The review was stratified by HRB domain and each specific HRB was

summarized. We therefore examined those studies exploring more than one behavior several times (as many times as the number of behaviors explored in the study). HRB strata were substance use, sexual behavior, nutrition, physical activity, and other HRB and multiple HRB indicators. We also provided a graphical representation of the interrelationships between self-esteem and the health risk behaviors.
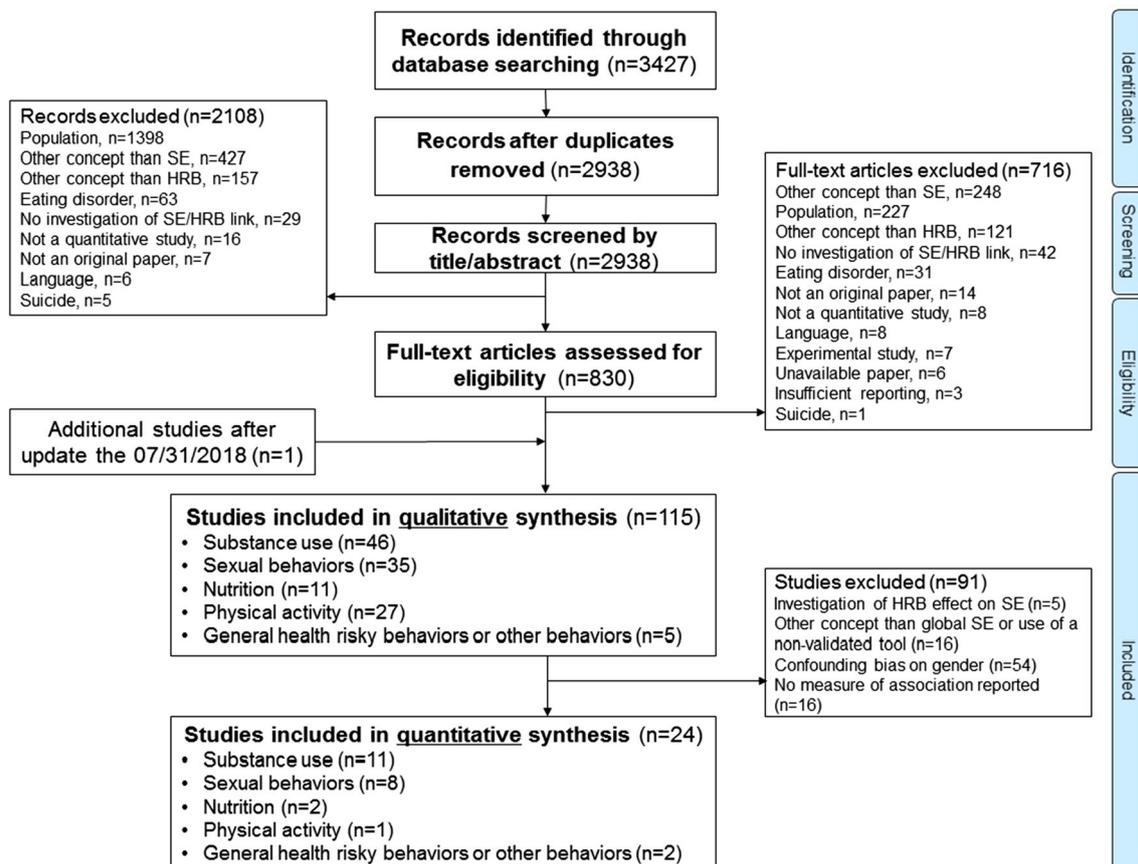
Results

Included Studies

Figure 1 illustrates the study selection flowchart. The key word search initially identified 2938 articles. After initial screening based on the titles and abstracts, 830 articles remained for full assessment, of which 716 were excluded. Reference lists of included articles were also checked but did not reveal any further relevant articles. The reasons for exclusion were mostly because these studies did not examine college student populations or did not relate to the concept of self-esteem or HRB. After the limited update, one article was added. Thus, a total of 115 articles were finally included and

the full list is available in supplemental material D. A qualitative synthesis was performed for each HRB stratum. We identified 46 studies on substance use, 35 on sexual behaviors, 11 on nutritional habits, 27 on physical activity, 4 on other HRB (i.e., sun risk behavior, gambling, problematic internet use, and traffic accidents), and 1 examining a single indicator of multiple HRB (i.e., combination of preventive behaviors). The studies are presented in detail in supplemental material E. A synthesis of risk of bias for each study depending on the type of HRB is presented in supplemental material F. Twenty-four studies were then included for the quantitative synthesis (see supplementary material A for details).

Characteristics of the Included Studies

The total number of participants included in the current review was 74,025. The sample sizes of the 114 studies varied widely between 44 and 9500. The publication years ranged from 1972 to 2017 and 32 of the 115 studies were published within the last 5 years (from 2013 to 2017). Most of the studies were cross-sectional ($n = 96$) and 19 studies were longitudinal. Most of the studies were conducted in America ($n = 90$), five in Canada, nine in Europe (Netherlands, Finland, Italy,

SE: self-esteem; HRB: health risk behavior

Fig. 1 Flow diagram (model PRISMA)

Norway, Spain, Croatia, and Slovakia), two in Oceania (Australia and New-Zealand), five in Asia (Turkey, Iran, and Palestine), and one in South-Africa. One study recruited participants in the USA and Jamaica and one study in the USA and China. Sixteen studies recruited first year students, 52 studies recruited undergraduate students (i.e., first to third year students), 1 study recruited final-year students, and 46 studies recruited large populations of university students from all years of study. Most studies included both male and female participants ($n = 90$) and of those studies, 66 studies included more females than males. Twenty-one studies included only females and 4 studies only males.

Assessment of the association between self-esteem and HRB was the primary objective in 25 of the studies. Almost half of these studies ($n = 12$) investigated alcohol consumption. Sixty-eight studies investigated this association within a broader investigation of multiple HRB. Among these 68

studies, those investigating sexual behavior ($n = 22$) and exercise ($n = 13$) were the most represented. The remaining 22 studies investigated the association between self-esteem and HRB as a secondary objective.

Most of the studies investigated the association between HRB and global self-esteem ($n = 104$). The RSE scale was mostly used for measuring global self-esteem ($n = 82$). However, the calculations of the self-esteem score with the RSE scale were heterogeneous: (1) a global score by summing all items, (2) separate scores for positive and negative items, or (3) a mean of separate items. Four studies measured contingent self-esteem, two measured physical self-esteem, one measured intellectual and social self-esteem, one measured decisional self-esteem, one measured academic and social self-esteem, one measured implicit self-esteem (in combination with global self-esteem), and one did not report any information about self-esteem measurement (Table 1).

Table 1 Description of methods used across the studies included in the systematic review investigating the association between self-esteem and health-related behaviors among college students

Health risk behavior and outcome studied	N studies included	N longitudinal studies	N studies investigating global self-esteem
Alcohol	37	6	31
- Frequency	26	3	21
- Abuse	12	2	12
- Binge drinking	7	1	7
Tobacco	10	2	10
- Number of cigarette	6	1	6
- Smoking status	4	1	4
Drug use	4	1	4
Global substance use	5	0	5
Sexual behavior	35	7	31
- Casual sex	8	5	8
- Pregnancy risk	5	1	5
- Condom use	5	0	5
- Number of partners	10	0	10
- Global sexual risk	11	1	8
Nutrition	11	1	10
- Unhealthy diet	3	0	2
- Dieting	6	0	5
- Intuitive eating	2	1	2
Physical activity	27	4	23
- Sport participation	7	1	6
- Frequency	18	2	13
- Other	2	0	0
Other	4	0	3
- Tanning bed	1	0	1
- Internet use	1	0	0
- Driving accident	1	0	1
- Gambling	1	0	1
Global risk	1	0	1

In some studies, more than one HRB was investigated. Thus, the same study may be cited several times according to the behaviors described

Most of the studies ($n = 102$) investigated only 1 HRB, whereas 13 studies estimated the association between self-esteem and more than 1 HRB (e.g., alcohol, tobacco and exercise). These studies mostly investigated alcohol with another HRB ($n = 10$).

Qualitative Synthesis

We report here a qualitative synthesis of the 115 studies by type of behavior.

Substance Use ($n = 46$)

Among the 46 studies on substance use, 37 investigated the association of self-esteem with alcohol consumption, 10 with tobacco consumption, 4 with drug use, and 5 with an indicator of substance use combining several substances.

Alcohol ($n = 37$)

Study Characteristics Most of the studies on alcohol consumption assessed frequency of consumption ($n = 26$) [38–63], while others assessed alcohol abuse ($n = 12$) [47, 48, 54, 64–72] and binge drinking behavior ($n = 7$) [44, 52, 55, 57, 70, 73, 74]. Six studies were longitudinal, with three studies reporting a long follow-up period (16, 4, and 1 year) [55, 64, 71], whereas three studies followed students for 1 day, 30 days, and 8 weeks [39, 59, 61]. Three recent studies (since 2013) included a large sample size (> 5000 participants) [54, 69] and two less recent studies were based on small samples (< 100 participants) [41, 63]. Self-esteem was evaluated using a global self-esteem scale by 31 studies, of which 24 studies with the RSE scale [38, 41, 44–46, 48, 50, 52, 54–59, 61, 64–66, 68–73], and 7 with other scales [49, 51, 53, 60, 63, 67, 74]. Three studies collected implicit or contingent self-esteem in addition to the RSE scale [39, 47, 59]; three studies used a morally and relationship based self-esteem scale [40, 42, 43] and one study used a decisional self-esteem scale [62]. Most of the studies ($n = 24$) included undergraduate students or a restricted age group of students (18–25 years) [38, 39, 42–45, 47–53, 56, 58, 60, 62–65, 67, 68, 71, 73]. Most of the studies ($n = 33$) were conducted among American students (in the USA or Canada) [38–51, 53, 55–61, 63–73]. Only one study was conducted in a European country (i.e., Norway) [74], two in New-Zealand and Australia [54, 62], one in South-Africa [52], and none in an Eastern country.

Risk of Bias Assessment Among the 37 studies, only 14 used multivariate analysis (adjusting on sex, age, ethnicity, personal and parental income, personality, social support, religious activity, well-being, personal and family alcohol history, context of drinking, other HRB) [39, 44, 47, 48, 51, 54–56, 58, 59, 71, 72, 74, 75]. For alcohol consumption assessment, 11 studies used validated tools (i.e., breath sample, Daily Diary Questionnaire, Annual Absolute Alcohol Intake, or Alcohol Use Disorders Test-C (AUDIT-C)) [38, 40–42, 45, 47, 48, 54, 56, 58, 62], whereas the other 15 studies employed new questionnaires created ad hoc for the study [39, 43, 44, 46, 49–53, 55, 57, 59–61, 63]. For alcohol abuse, all the studies were based on a validated measurement tool (i.e., Diagnostic and Statistical Manual of Mental Disorders III (DSM III), AUDIT-C, Rutgers Alcohol Problem Index (RAPI), CAGE questionnaire, Michigan Alcohol Screening Test (MAST)). Binge drinking was defined differently among the studies; (a) with a single cut-off for men and women among three studies [55, 57, 74]; (b) separate cut-offs for men and women in two studies [44, 70]; and (c) based on the College Alcohol Study scale for one study [73]. One study did not define binge drinking [52]. No study reported having performed a sample size analysis to ensure statistical power.

1. Alcohol consumption ($n = 26$)

Statistical Association Among the 26 studies, 9 found a significant association [38, 41–45, 51, 56, 59, 63], including 1 that found a significant association only among females [38], 2 studies investigated the association with contingent self-esteem [42, 43], and 1 with implicit self-esteem [59]. Four found positive associations [43–45, 51, 63], whereas four found negative associations [38, 42, 56, 59]. One study reported a positive association for males and a negative association for females [41].

Among the 16 studies that found no association [39, 40, 46–50, 52–55, 57, 58, 60–62], 4 studies investigated the association with dimensional measures of self-esteem (i.e., contingent self-esteem, implicit self-esteem and decisional self-esteem) [39, 40, 48, 62] and 2 were based on female participants [50, 53]. One study found an association with implicit self-esteem but not with explicit self-esteem [59].

Strength of the Association For some studies, an effect size was estimated when a significant association was found. The strength of the associations varied from weak to moderate, considering what was reported in each study: (a) correlational analyses were computed in two studies, reporting $r < 0.5$ [43, 63]; (b) regression analyses were conducted in three studies, showing positive regression coefficients varying from 0.03 to 0.44 for an increase of one point on the RSE Scale [41, 44, 45]; and (c) regression analysis showed a negative relationship in four studies, with regression coefficients of -0.11 and -0.70 respectively for an increase of one point on the RSE Scale [41, 56], -0.22 for an increase of one point in morally based self-esteem [42], and -0.11 for an increase of one point in implicit self-esteem score [59].

Directionality of the Association Three longitudinal studies investigated the self-esteem effect on prospective alcohol consumption and reported no association [39, 55, 61], whereas one study found a positive association: high implicit self-esteem was associated with higher number of alcoholic drinks consumed the following day [59].

2. Alcohol abuse (*n* = 12)

Statistical Association Among the 12 studies retrieved, 9 found a significant association [47, 54, 64–67, 69–71]. All the significant associations were negative, except for one study that reported a positive association among males [54].

Among the four studies that found no association [47, 48, 68, 72], one investigated the association with contingent self-esteem and found no association, whereas global self-esteem was significantly associated with alcohol abuse [47].

Strength of the Association For some studies, an effect size was estimated when a significant association was found. The strength of the associations varied from weak to moderate considering what was reported in each study: (a) in three studies, correlational analysis reported weak associations ($r < -0.5$) [64, 65, 69]; (b) in one study, correlational analysis reported a moderate association ($r = -0.54$) [67]; (c) in one study, regression analyses were conducted, showing positive regression coefficients varying from 0.26 to 0.32 for an increase of one point on the RSE Scale [54]; and (d) in three studies, regression analysis showed a negative relationship, with regression coefficients of -0.15 and -0.19 for an increase of one point on the RSE Scale [47, 70, 71].

Directionality of the Association One longitudinal study found that lower self-esteem predicted alcohol abuse only among women (negative association), whereas alcohol abuse predicted lower self-esteem only among men (negative association) [71]. The other longitudinal study found an effect of alcohol abuse on prospective lower self-esteem (negative association) [64].

3. Binge drinking (*n* = 7)

Statistical Association Among the seven studies, two found a significant association [73, 74], including one that found a significant association only among female students [73]. All the significant associations were positive.

Five studies found no association [44, 52, 55, 57, 70].

Strength of the Association Only one study estimated an effect size, with a regression analysis reporting a positive regression coefficient of 0.92 for an increase of one point on the Torgersen's Basic Character Inventory [74].

Directionality of the Association The only longitudinal study found no association between self-esteem and prospective assessment of bingeing behavior [55].

Tobacco (*n* = 10)

Study Characteristics Nine studies investigated the association between self-esteem and cigarette tobacco use [46, 49–52, 61, 76–78], and one studied self-esteem and hookah use [75]. Two studies were longitudinal with follow-up durations of 8 weeks and 1 year respectively [61, 75]. One study included more than 100 participants [76], and the others included between 212 and 830 participants. Self-esteem was evaluated exclusively by a global self-esteem measure, with eight studies using the RSE scale [46, 50, 52, 61, 75–78]. Most of the studies (*n* = 6) included undergraduate students or restricted age groups of students (18–25 years) [49–52, 75, 76] and two studies included exclusively female students [50, 75]. Most of the studies (*n* = 7) were conducted among North-American students (in the USA or Canada) [46, 49–51, 61, 75, 76]. One study was conducted in a European country (i.e., Slovakia) [77], and one study in South-Africa [52].

Risk of Bias Assessment Half of the studies used multivariate analysis (*n* = 5, i.e., sex, age, personality, stress, other health-behavior) [49, 51, 75–77]. The studies assessed smoking by two types of measurement: number of cigarettes smoked (mostly in the past month) for six studies [46, 49, 50, 52, 61, 78] or smoking status with different definitions for four studies (hookah use once in the year, smoked at least one cigarette in the past month, and more than 100 times in their life or at least one cigarette per day in the past month) [51, 75–77]. No study reported having performed a sample size analysis to ensure statistical power.

1. Number of cigarettes smoked (*n* = 6)

Statistical Association Among the six studies, three found a significant association [50, 61, 78]. All the significant associations were negative.

Strength of the Association For the three studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak: correlation coefficients varied between -0.14 and -0.24 [50, 61, 78].

Directionality of the Association The only longitudinal study reported a significant effect of lower self-esteem on prospective tobacco consumption (negative association) [61].

2. Smoking status (*n* = 4)

Statistical Association Among the four studies, two found a significant association [51, 77]. One found a significant negative association only among female students [77]. One study found a significant positive association [51].

Strength of the Association Only one study estimated an effect size: odds ratio for negative self-esteem versus positive self-esteem was 1.17, showing a moderate effect size [77].

Directionality of the Association The only longitudinal study found no association between self-esteem and prospective assessment of hookah initiation [75] .

Drug use ($n = 4$)

Study Characteristics Four studies investigated the association between drug use and self-esteem [46, 52, 61, 79]. One study was longitudinal with 8 weeks' follow-up [61]. Studies included between 212 and 799 participants. Self-esteem was evaluated exclusively by the RSE scale. Two studies included undergraduates or restricted age groups of students (18–25 years old) [52, 79]. Two studies were based on North American populations (USA or Canada) [46, 61], one study on South-Africa [52], and one on Turkish students [79].

Risk of Bias Assessment The risk of confounding bias was taken into account only in one study, using multivariate analyses (i.e., parental education, sensation seeking, other HRB) [79]. One study focused on marijuana use [61], whereas the others focused on a more global indicator of drug use (i.e., use of cannabis, hashish, LSD, cocaine, amphetamines, other opiates; or not clearly reported definition). No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the four studies, two found a significant association [52, 61]. One study found a significant association between self-esteem and marijuana [61]; one study found a significant association with sedative use among men and with cannabis and other opiates among women [52]. All the studies found a significant negative association.

Strength of the Association Only one study estimated an effect size: the correlation coefficient was -0.21, showing a weak effect size [61].

Directionality of the Association The only longitudinal study found a significant negative association between self-esteem and prospective assessment of cannabis use [61].

Global Substance Use Indicator ($n = 5$)

Study Characteristics Five studies investigated the association between global substance use and self-esteem [46, 80–83]. All the studies were cross-sectional and included between 243 and 506 students, whereas 1 study included 2407 participants [83]. Self-esteem was evaluated exclusively by a global self-esteem measure, including three studies with the RSE scale [46, 80, 81]. Two studies included undergraduate students [82, 83]. Three studies were conducted among American students (USA) [46, 80, 82], and two on European populations (Finland and Spain) [81, 83].

Risk of Bias Assessment No study used multivariate analyses. One study focused on mixed use of alcohol and psychiatric drugs [83], whereas the others used an indicator for consumption of alcohol, tobacco, and drugs (including one study based on the CAGE questionnaire) [81]. No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the five studies, two found a significant association [80, 83]. One study found a significant negative association with mixed use only among men [83]. One study found a significant positive association with a global substance use indicator [80].

Strength of the Association Only one study estimated an effect size: the correlation coefficient was 0.12, showing a weak effect size [80].

Sexual Behaviors ($n = 35$)

Among the 35 studies on sexual behavior, 8 investigated the association of self-esteem with casual sex or hookups, 5 with pregnancy risk, 5 with condom use, 10 with number of partners or number of intercourse acts, and 11 with a global sexual risk indicator combining different behaviors.

1. Casual Sex ($n = 8$)

Study Characteristics Among the eight studies on casual sex [84–91], five were longitudinal with 10 weeks to 1-year of follow-up [86, 87, 89–91]. One study included more than 3000 participants [85]; the others included between 140 and 666 participants. Self-esteem was exclusively evaluated by a global self-esteem score, using the RSE scale, except for one study that used the Harter's Self-perception Profile [88]. All the studies included freshmen or undergraduate students, and one study included exclusively female students [86]. All the studies were conducted in the USA. Studies focusing on casual sex were all performed from 2010 onwards.

Risk of Bias Assessment Most of the studies used multivariate analyses ($n = 5$, i.e., sex, well-being, education level, hookup history, alcohol consumption, ethnicity, socio-economic status, personality) [86–88, 90, 91]. In some studies, casual sex or hookups were not clearly defined. Two studies were based on the definition of Paul 2000: "a sexual encounter, usually only lasting one night, between two people who are strangers or brief acquaintances. Some physical interaction is typical but may not include sexual intercourse" [84, 88]. There were differences also depending on what type of sexual intercourse was under study (oral or penetrative sex) and whether the relationship with casual partners was a one-time relationship or longer. No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the eight studies, four found a significant association [85–88]. Three studies found a significant negative association [85, 86, 88]. One study found a significant positive association only among women [87].

Strength of the Association For the two studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak considering what was reported in each study: (a) the correlation coefficient was -0.12 [86]; (b) the regression coefficient was -0.03 for an increase of one point on the RSE scale [85].

Directionality of the Association Two longitudinal studies reported a significant negative association between self-esteem and prospective casual sex for one [86] and between casual sex and prospective self-esteem for the other one [87]. Both studies were among women.

2. Pregnancy Risk ($n = 5$)

Study Characteristics Among the five studies on pregnancy risk [92–96], one was longitudinal with a one-semester follow-up duration [96]. One study included 81 participants [93], the others included between 273 and 837 participants. Self-esteem was evaluated exclusively by a global self-esteem measure using the RSE scale except for one study that used the Texas Social Behavior Inventory [93]. Three studies included sexually active female students [94–96]. All the studies were conducted in the USA.

Risk of Bias Assessment Only one recent study used multivariate analyses (i.e., ethnicity, number of sex partners, age of first intercourse) [95]. One study used a complex indicator of pregnancy risk (i.e., index consisting of the product of the woman's frequency of intercourse over the last 6 months, the failure rate of her usual contraceptive method, and perceptions of comparative vulnerability to unplanned pregnancy) [96], while other studies

assessed use of contraceptive methods (but only one study used a validated scale) [92]. No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the five studies, two found a significant negative association [92, 95].

Strength of the Association For the two studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak to moderate considering what was reported in each study: (a) the correlation coefficient was $r = 0.20$ [92]; (b) the odds ratio was 1.39 for an increase of one point on the RSE Scale [95].

Directionality of the Association The only longitudinal study found no association between self-esteem and prospective assessment of pregnancy risk [96].

3. Condom Use ($n = 5$)

Study Characteristics The five studies on condom use were cross-sectional [97–101]. One study included 832 participants [100], while the others included between 159 and 260 participants. Self-esteem was evaluated exclusively by a global self-esteem measure including three studies using the RSE scale [99–101]. Three studies included male and female undergraduates [99–101], and one study female students only [97]. All the studies were conducted in the USA, except for one in Slovakia [100] and a multicenter study in the USA and Jamaica [97].

Risk of Bias Assessment Only one study used multivariate analysis (i.e., religious activity, well-being, personality, alcohol, and smoking consumption) [100]. One study used a validated scale (The Condom Use Scale) [99], while others used a tool designed ad hoc for the study with no clear definition [98, 101], except frequency for one study [100]. No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the five studies, four found a significant association [97–99, 101]. They reported a significant positive association. For one study, this association was found only for students categorized as low drinkers [101].

Strength of the Association Two studies found a significant effect size showing a weak association, with correlation coefficients varying between $r = 0.18$ and $r = 0.30$ [97, 99].

4. Number of Partners or Intercourse Acts ($n = 10$)

Study Characteristics All the studies on the number of partners or intercourse acts were cross-sectional [80, 93, 100,

102–108]. Two studies included less than 100 participants (75 and 81) [93, 103], the others included between 124 and 832 participants. Self-esteem was evaluated exclusively by a global self-esteem measure including six studies using the RSE scale [80, 100, 102, 104, 107, 108]. Six studies included undergraduate students [93, 100, 102–105]. One study recruited only women [104] and another only self-identified heterosexual participants [102]. Most of the studies ($n = 9$) were conducted in North-America (USA or Canada) [80, 93, 102–108] and one study in Slovakia [100].

Risk of Bias Assessment Only four studies used multivariate analysis (i.e., age, sex, personality, religious activity, relationship status, alcohol consumption, well-being, sex before the age of 16) [100, 104, 106, 108]. The studies used different definitions of the number of partners or intercourse acts: using the number of partners as a continuous variable [80, 93, 102, 104–108] or categorized as virgins or not and having experienced four or more partners in life or not [100, 103]. The studies referred to different periods of time :lifetime [93, 100, 102, 103, 105, 106], past year [80, 107, 108], past 4 weeks [104]. No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the ten studies, four found a significant association [102, 105, 106, 108]. One study found a significant association only among women [102], whereas two studies found a significant association only among men [105, 106]. All the studies reported a significant positive association.

Six studies found no association between self-esteem and the number of partners or intercourse acts [80, 93, 100, 103, 104, 107]; one study was only among women [104].

Strength of the Association For the four studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak considering what was reported in each study: (a) in two studies, correlational analyses were computed, reporting $r < 0.5$ ($r = 0.12$ and $r = 0.23$) [102, 105]; (b) in two studies, regression analyses were conducted, showing positive regression coefficients of 0.25 for an increase of one point on the RSE scale [54] and 0.27 for an increase of one point on the Self-satisfied-dissatisfied with myself scale [106].

5. Global Sexual Risk ($n = 11$)

Study Characteristics Among 11 studies on global sexual risk [65, 97, 100, 109–116], 1 was longitudinal with 8 weeks of follow-up and 77 participants [111]. The other studies were cross-sectional and included between 132 and 832 participants and 1 study included 9500 participants [65]. Self-esteem was mostly evaluated by a global self-esteem measure, including

eight studies using the RSE scale [65, 97, 100, 109, 110, 112, 113, 116] and one used a measure of sexual self-esteem [114]. Nine studies included undergraduate students or traditional aged students (below 25 years old) [65, 97, 100, 109–111, 113, 114, 116]. Three studies recruited only women [97, 111, 114], and another one only self-identified heterosexual male participants [109]. Most of the studies were conducted in the USA ($n = 8$) [65, 109–113, 115, 116], one study included both American and Jamaican participants [97], one study was performed in Australia [114], and another in Slovakia [100].

Risk of Bias Assessment Only four studies used multivariate analyses (i.e., age, sex, religious activity, personality, well-being, relationship status, sexual orientation, type of sexual behavior, age of first intercourse, alcohol, and smoking consumption) [100, 109, 110, 116]. Studies employed different definitions of global sexual risk: using different risk combinations (condom use and number of partners were mostly used) and using a positive or negative indicator (risk sex [65, 97, 100, 110–115] vs. safe sex [109, 116]). The studies referred to different periods of time (lifetime [100, 109, 114, 116], past year [110], past 6 months [97, 111], and past 30 days [65]). No study reported having performed a sample size analysis to ensure statistical power.

Statistical Association Among the 11 studies, 6 found a significant association [65, 97, 109, 112, 115, 116]; 1 study was performed only among women [97]; and 1 study only among men [109]. One study found a significant association only among women [116]. Three studies found a significant negative association [65, 97, 115], whereas three studies found a significant positive association [109, 112, 116].

Five studies found no association between self-esteem and global sexual risk [100, 110, 111, 113, 114]; one was performed only among women [111].

Strength of the Association For some studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak considering what was reported in each study: (a) in three studies, correlational analyses were computed, reporting $r < -0.2$ [65, 97, 115]; (b) in two studies, regression analyses were conducted, showing positive regression coefficients varying from 0.16 to 0.28 for an increase of one point on the RSE scale [109, 116].

Directionality of the Association The only longitudinal study found no association between risky sexual behavior and later self-esteem [111].

Nutrition ($n = 11$)

Study Characteristics Most of the studies ($n = 6$) on nutrition assessed dieting [117–122], while others assessed intuitive

eating behavior (i.e., propensity to follow hunger and satiety cues when deciding how much, when and what to eat [123]) [124, 125], including one longitudinal study of an 8-day daily diary [124], unhealthy weight loss behavior [126, 127], and healthy diet [60]. Studies included between 322 and 699 participants, whereas the longitudinal study included 92 participants [124]. Self-esteem was evaluated by a global self-esteem scale in ten studies, including seven studies using the RSE scale [117, 118, 121, 124–127]. One study investigated appearance and social self-esteem [119]. Most of the studies (n = 9) included undergraduate students [60, 117–120, 122, 124–126] and four studies recruited only women [117, 121, 124, 125]. Seven studies were conducted in North-America (USA or Canada) [60, 117, 119, 122, 124–126], two studies were performed in Middle Eastern countries (Palestine [118] and Turkey [121]), one in the Netherlands [127], and one recruited participants both in the USA and Hong-Kong [120].

Risk of Bias Assessment Only two studies used multivariate analyses (i.e., BMI, sex, ethnicity, personality) [124, 126]. Several studies used validated tools (The Dutch Eating Behavior Questionnaire or the Intuitive Eating Scale) or a clear definition for dieting except for one study [121]. Only the Palestine study performed a sample size analysis and reported enough statistical power (calculation taking into account the large number of predictors analyzed) [118].

Statistical Association Among the 11 studies, 7 found a significant association [60, 117, 120, 124–127]. Two studies found a significant negative association among women for dieting behavior (i.e., higher self-esteem associated with lower dieting behavior) [117, 120], whereas four studies found no association [118, 119, 121, 122]. Two studies investigating intuitive eating among women found a positive association [124, 125]. Two studies investigating unhealthy weight loss behavior found a significant negative association [126, 127]. The study on healthy diet found a significant positive association [60].

Strength of the Association For some studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak to moderate considering what was reported in each study: (a) in three studies, correlational analyses were computed, reporting $r < 0.4$ [60, 120, 125]; (b) in two studies, regression analyses were conducted, showing a positive regression coefficient of 0.02 [124] and an odds ratio of 0.90 for an increase of one point on the RSE scale [126].

Directionality of the Association The only longitudinal study found a significant positive association between self-esteem and prospective intuitive eating [124].

Physical Activity (n = 27)

Study Characteristics Among the 27 studies investigating physical activity [50, 60, 72, 119, 120, 128–150], 4 studies were longitudinal, with 3 days to 3 weeks of follow-up [130, 139, 145] and 1 study with 9 years of follow-up [144]. Three studies included a large sample (> 1000 participants) [138, 141, 144] and 2 were based on small samples (< 100 participants) [128, 130]. Self-esteem was evaluated by a global self-esteem score in 23 studies, including 17 studies using the RSE scale [50, 72, 128–130, 132–134, 136, 139, 141–143, 146–150]. Other studies measured intellectual [144], appearance, social [144], contingent [135], or physical self-esteem [140]. A large number of studies (n = 16) included undergraduate students or restricted age groups of students (18–25 years) [50, 60, 119, 120, 128, 131–133, 135, 136, 140–142, 144, 145, 148]. Seven studies were performed only among women [50, 134, 138, 141, 142, 145, 147]. Three studies were performed only among men [129, 144, 146]. Most of the studies (n = 22) were conducted among North-American students (USA or Canada) [50, 60, 72, 119, 128, 131–140, 142, 144–150]. Two studies were conducted in European countries: Spain [143] and Croatia [141], two studies in Middle-Eastern countries: Iran [130] and Turkey [129], and another study compared students in the USA and China [120].

Risk of Bias Assessment Only five studies used multivariate analysis (i.e., sex, age, ethnicity, family socioeconomic status, education degree, physical competence, academic achievement, social involvement, occupational status aspirations, college academic selectivity, major field study, body image, masculinity, sport enjoyment) [128, 135, 144, 147, 148]. Seven studies investigated sports participation in college [129, 130, 134, 144, 147–149], 18 studies measured frequency and duration of physical activities [50, 60, 72, 119, 120, 128, 131–133, 136–141, 143, 145, 146, 150] during different periods (1 week to 1 month), including 3 studies using the Godin score (computed with the Godin Leisure-Time Exercise Questionnaire) [137, 140, 150], and 1 using a pedometer [145]. One study measured drive for muscularity [135] and another the use of fasting [142]. No study reported having performed a sample size analysis to ensure statistical power.

1. Sport Participation in College (n = 7))

Statistical Association Among the seven studies, six found a significant association [129, 130, 134, 144, 147, 148]. One study found a significant association with social self-esteem but not with intellectual self-esteem [144]. Four studies found a significant positive association, including one study performed among men [144] and another study among women [134]. One study performed among women reported a

significant positive association that turned to a significant negative association when sport enjoyment was entered in the model [147]. A study performed among men found a significant negative association [129].

Strength of the Association For some studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak considering what was reported in each study: (a) in one study, a correlational analysis was computed, showing $r = 0.11$ [134]; (b) in one study, a regression analysis was conducted, showing a positive regression coefficient of 0.14 for an increase of one point on the RSE scale [148]; (c) in one study, regression analysis was conducted and showed a positive regression coefficient of -0.16 for an increase of one point on the RSE scale [147]; (d) in one study, ordinary least square analysis reported a coefficient of 0.05 and 0.13 for Caucasian and African-American men for an increase of one point on the social self-esteem scale [144].

Directionality of the Association One longitudinal study found that participation in intercollegiate athletics predicted high social self-esteem among men (negative association) [144].

2. Frequency and Duration of Physical Activities ($n = 18$)

Statistical Association Among the 18 studies, 13 found a significant association [50, 60, 119, 120, 131, 132, 136–141, 143]; 3 studies were performed only among women [50, 138, 141] and 1 only among male students [137]. One study found a significant association with social self-esteem, but not with appearance self-esteem [119] and one study found a significant association with physical self-esteem [140]. Ten studies found a significant positive association including one study performed among men [137] and two among women [50, 138]. Three studies found a significant negative association [60, 120, 139].

Five studies found no association [72, 128, 133, 145, 146, 150], including one among women [145] and one among males [146].

Strength of the Association For some studies in which a significant association was found, an effect size was estimated. The strength of the associations was weak considering what was reported in each study: (a) in eight studies, correlational analysis was computed, reporting $r < 0.40$ for global self-esteem [50, 60, 120, 136–139] and for social self-esteem [119]; (b) in two studies, a regression analysis was conducted, showing a positive regression coefficient of 0.16 for an increase of one point on the Coopersmith self-esteem scale [131] and 0.10 for an increase of one point in physical self-esteem [140].

Directionality of the Association One of the two longitudinal studies found that high self-esteem was associated with

prospective frequency or the duration of physical activity (negative association) [139].

3. Drive for Muscularity or Use of Fasting ($n = 2$)

Statistical Association Two studies found a significant association [135, 142]. One study was performed only among women and found a negative association between exercise or fasting and self-esteem [142]. One study reported a significant positive association between drive for muscularity and self-esteem only among males, and not among women [135].

Strength of the Association Only one study estimated an effect size: the regression coefficient was 0.39 for an increase of one point in contingent self-esteem, showing a weak effect size [135].

Other Health Behavior and Multiple Health Behavior Indicator ($n = 5$)

One cross-sectional study investigated the association between sun risk behavior and global self-esteem (measured by the Hudson's scale) among 745 US undergraduate students [49]. Past summer sun exposure and tanning bed use during the last year were collected. Multivariate analysis (adjusted on sensation seeking, smoking, drinking, sex, age) did not show a significant association.

One cross-sectional study investigated the association between gambling and decisional self-esteem (measured by the Multidimensional Mood State Questionnaire) among 464 Australian undergraduate students [62]. Gambling was evaluated by a validated scale (i.e., the South Oaks Gambling Screen). Mean comparison showed a significant negative association.

One cross-sectional study among 76 US undergraduate students investigated the association between traffic accidents and global self-esteem [151]. Data about traffic accidents was collected by an ad hoc questionnaire. Correlational analysis showed a weak significant negative association (i.e., $r = -0.25$).

One cross-sectional study among 157 Italian undergraduate students investigated the association between problematic internet use and global self-esteem (measured by the RSE scale) [152]. Problematic internet use was estimated by a validated scale (i.e., The Generalized Problematic Internet Use Scale). Multivariate analysis (adjusted on age, sex, reasons to use internet, shyness, and loneliness) led to a non-significant association.

One cross-sectional study investigated the association between global behavior and global self-esteem (measured by the RSE scale) among 793 US students [153]. Based on a modified 22-item form of the Center for Disease Control and Prevention's Behavioral Risk Factor Questionnaire (CDC,

1996), the total health behavior score was positively associated with self-esteem. The regression coefficient was estimated to be 0.04 for an increase of one point on the RSE scale, showing a weak association.

Figure 2 describes the graphical representation of the inter-relationships between self-esteem and the HRB that have arisen in this systematic review, combining both qualitative and quantitative syntheses.

Discussion

Statement of Principal Findings

In this systematic review, we were able to analyze the association between self-esteem and 4 HRB, based on 115 studies published from 1970 to 2017. The studies investigated associations between self-esteem and four HRB: substance use, sexual behavior, exercise, nutrition. Most studies reported that higher self-esteem was associated with healthier behavior. However, for alcohol consumption and number of sexual partners, both negative and positive associations have been reported. For substance use, the strongest evidence was for a negative association between self-esteem and alcohol abuse. Discordant results were reported for alcohol consumption (negative and positive associations reported). A smaller number of studies were conducted on tobacco and drug use. Associations were weak. Several longitudinal studies were in favor of a bidirectional effect. For sexual behavior, negative associations were reported between self-esteem and risky sexual behavior. On the contrary, positive associations were reported between self-esteem and number of partners. Associations were weak. Several longitudinal studies were in favor of a bidirectional effect. For exercise, studies were in favor of a positive association between self-esteem and exercise, concerning global self-esteem as well as social self-

esteem. Associations were weak. Several longitudinal studies showed a bidirectional effect. For nutrition, positive associations were reported between self-esteem and healthy nutrition. Associations were weak to moderate. A longitudinal study reported an effect of self-esteem on prospective healthy nutrition.

Strengths and Weaknesses of the Review

This review is the first to summarize empirical knowledge of the association between self-esteem and HRB. This large review was based on a sensitive algorithm applied to several bibliographic databases. This review was not restrained by any period limit, thus allowing recent (in the 2010s) and older (pre-1980) studies to be take into account. PRISMA statements were followed carefully. Two independent investigators performed a blinded study selection. Only one person carried out the data extraction. However, a pilot phase with two people served to validate the tool for the risk of bias assessment, with a very satisfying rate of agreement. A detailed qualitative study was performed on more than 100 studies. The quantitative synthesis was limited and did not allow us to pool the estimate because of the high heterogeneity of the measures, the high risk of bias, and the poor reporting of studies. Although we used a sensitive algorithm, publication bias may have arisen. However, we decided to include in this review only those studies published in peer-review journals, for their better methodology and reporting.

Meaning of the Review's Findings

We could not identify reasons for discrepancies between the results (which were not attributable to period profile, methodology differences, or differences in population characteristics). Global self-esteem was largely used across the studies and mostly assessed using the RSE
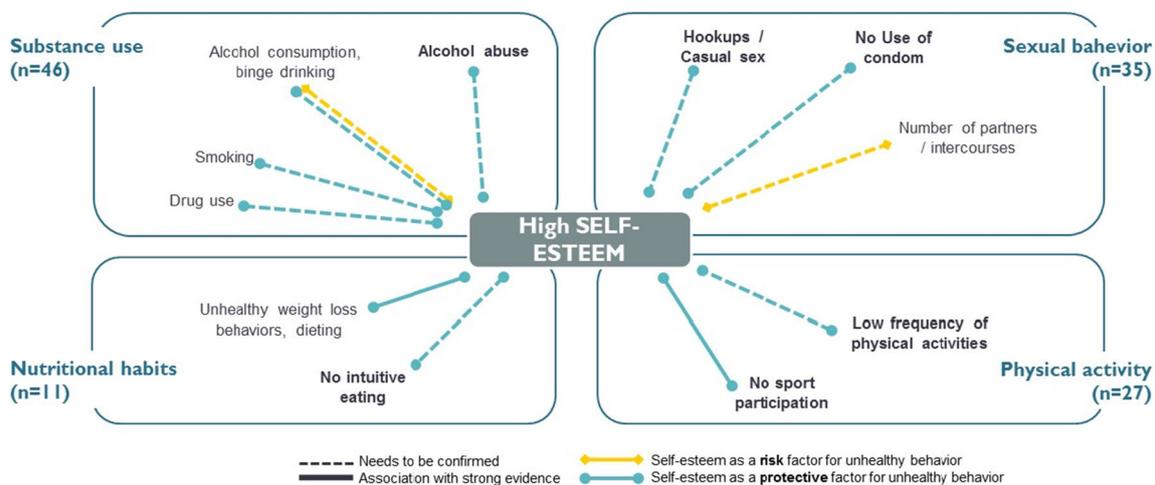

Fig. 2 Representation of hypothetical relation between self-esteem and health risk behaviors

scale. However, the self-esteem variable used in the analysis varied between studies, making comparison of the results difficult, in particular the strength of the association. Furthermore, dimensional scales of self-esteem were used for some studies. Social self-esteem seems to be associated with physical activity, whereas contingent self-esteem may rather be associated with alcohol consumption. Concerning risk of bias, we have highlighted the lack of sample size calculations for almost all the studies. This limitation prevented us from distinguishing a probable non-significant association from a lack of statistical power. In addition, many studies were based on correlational analysis (corresponding to older studies or self-esteem as a secondary objective of the study). Finally, a confusion bias could arise and limited the validity of these results because of insufficient adjustment, especially when sex was not taken into account. Most of the studies were conducted among US students and environmental and social contexts are closely linked with self-esteem and behaviors. Moreover, the studies were mostly based on the lower grades (freshmen or sophomores). The limited population types investigated may diminish the generalization of the results. We recommend further research to extend knowledge of those HRB that have received less attention (i.e., tobacco, drug use, nutrition) or provide stronger evidence of causality for other HRB (e.g., alcohol, sexual behavior, exercise). These studies should focus on self-esteem/HRB associations as a primary objective and follow guidelines for observational studies (i.e., STROBES statements). More particularly, limiting biases and providing transparent reports (i.e., effect estimation and confidence interval) should be central issues in further studies in this area. If such studies were implemented, a formal meta-analysis providing pooled estimates would become feasible, which would be of the utmost importance in order to support interventional research.

Implications

The results showed global coherence of the evidence in favor of an effect of self-esteem on HRB. However, there are limitations that diminish the interpretation especially in terms of effect size. There is a need for studies that bring solid arguments in terms of causality (i.e., large sample size, broad adjustment, prospective design, and clear and valid definition and assessment of HRB). Since self-esteem has non-consensual definition, it is not surprising that its measurement was heterogeneous in retrieved articles. However, even when the same instrument was used, there was heterogeneity in the variable used to obtain the score. This implies limitations in the validity of the measure and the comparison of the results across studies. We recommend to systematically measure global self-esteem through tools commonly used in the international literature (e.g., the RSE scale, [154]) and compute global score as described by the validation studies. In addition to the global measure, we also recommend to use a dimensional measure of self-esteem. Considering that this research is rather new, we do not recommend to focus on a specific dimension but to pursue the exploration of a large variety of them.

Despite Jessor's theory which implies a common approach for HRB, the empirical data described in this review has shown divergent results according to the different HRB (e.g., positive association for alcohol consumption but negative association for condom use). We therefore recommend investigating HRB both separately and in combination. Another way to consider further research could be to differentiate behaviors that have an impact on health but are highly socially accepted in the student population (e.g., alcohol consumption, multiple sexual partners) versus known and less desirable risky behaviors (no condom use, sedentariness, drug use). More generally, high heterogeneity in the definition of HRB is a huge challenge to synthetize knowledge about determinants of HRB. For instance, alcohol consumption can be studied across several dimensions and definitions like binge drinking, alcohol abuse, frequency, or amount of alcoholic beverage. To address this complexity, we recommend to establish a consensus for these definitions.

Self-esteem seems to be a relevant target to identify vulnerable young adults and prevent the emergence or maintenance of HRB, especially alcohol abuse and physical activity. Concomitantly to empirical research, interventional studies should be conducted to evaluate self-esteem promotion programs in the university context. Efficient interventions already exist for children [155, 156] and could be transferred to college students (i.e., improving psychosocial abilities and self-knowledge). Other types of intervention could be experimented with, such as mentoring programs that could be suitable within a university setting by focusing on the social dimension of self-esteem.

Compliance with Ethical Standards

No individual data was analyzed in this study. Each study included in this review reported information about informed consent and ethical considerations that can be found in each manuscript.

Conflict of Interest   The authors declare that they have no conflict of interest.

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