Examining a biopsychosocial model of the development of body image, eating behaviors and weight in youth: An Ontario prospective longitudinal school-based study

Final Outcomes Report (Reference Number: RG-627)
16 October 2012

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Project Overview

Background. Eating disorders affect about 6% of youth. Their pivotal effect on health has led the World Health Organization to include them among the priority mental illnesses for children and adolescents. In the past few decades, overweight and obesity have risen 2-3 fold in adolescents. They are now considered a worldwide public health problem, associated with potentially devastating psychosocial and medical outcomes, premature mortality, and exorbitant costs for the health system ($2.5 billion annually in Ontario alone).

Objectives. Our program of research, the Ontario Research on Eating and Adolescent Lifestyles (REAL study), was designed to investigate across time the interlocking mechanisms that shape adolescents' body image, eating behaviour and weight, and to increase knowledge about risk and protective factors for both eating disorders and obesity. The objectives of this 2-year longitudinal school-based study were: (1) to investigate the biological, environmental, and individual factors that contribute to body image, eating behaviours, and body weight in adolescent boys and girls; (2) to test a developmental biopsychosocial model integrating the above factors to predict prospectively healthy or unhealthy eating and weight in adolescent boys and girls. It was hypothesized that factors within the biological, socio-environmental, psychological and behavioural domains would jointly predict eating disorders and obesity in youth, although the strength of the associations would differ from eating to weight disorders and between genders.

Methods. Through an ongoing partnership with three school boards (Ottawa Carleton District School Board, Ottawa Carleton Catholic School Board, Upper Canada District School Board) and several private schools in Ottawa and the surrounding region, we have constituted a longitudinal cohort of 1172 participants initially in grade 7 (mean age ± SD = 12.6 ± 0.4 years) or grade 9 (mean age ± SD = 14.7 ± 0.4 years) at first assessment. Of those, 40% are males and 60% are females. All participants are being surveyed annually using a package of reliable self-report questionnaires assessing the hypothesized risk and protective factors, as well as objective measures of weight and height. Validated measures are utilized to identify eating disorders (full- and partial-syndromes of anorexia nervosa, bulimia nervosa, binge eating disorder, and eating disorders not otherwise specified [EDNOS]), and classify adolescents into standard weight categories (thinness, normal weight, overweight, and obesity) based on internationally-based, sex- and age-specific BMI percentiles. The proposed model will be tested longitudinally across the two years of the study using multi-level modeling, to assess the predictive utility of the proposed model, and identify how variations in predictors influence outcomes.

Relevance and Originality. There is a growing recognition that both eating and weight disorders should be conceptualized within a shared theoretical framework to advance our etiopathogenic understanding of these complex disorders, and to design coherent and effective prevention and treatment strategies. REAL is the first study in Canada to assess simultaneously a wide range of risk and protective factors for both types of disorders, and to integrate, in a combined model, research previously conducted separately in the eating disorders and the obesity fields. Our findings will be translated into preventive interventions, the effectiveness of which can be tested in elementary and high school students, through our ongoing collaboration with academic and community partners, including the school boards and community support groups.
Purpose and Related Research

1. Eating and weight disorders in adolescents

Adolescence is a time of enormous changes in both eating behaviours and weight. Average weight gain during puberty is 14 kg for girls and 15 kg for boys, with marked differences in body shape between the sexes becoming evident. Due to high rates of body preoccupations and weight dissatisfaction, up to 60% of adolescent girls, and 29% of adolescent boys resort to dieting or other unhealthy weight control behaviors. Although the multiple physical, psychological, and social changes that occur during puberty usually resolve in successful life changes, adolescence has been shown to be the time of peak incidence for eating disorders, and a critical time for the development of lifelong weight problems.

Eating disorders (EDs) are characterized by a morbid preoccupation with weight and shape, and manifest through severely restricted, distorted or chaotic eating behaviors. Current diagnostic categories include: anorexia nervosa (AN), which typically begins in mid adolescence with the onset of dietary restriction that rapidly gets out of control; bulimia nervosa (BN), which has a slightly later age of onset, usually starts in much the same way as AN but quickly progresses to recurring cycles of binging and fasting or binging and purging; binge eating disorder (BED), distinguished from BN by the absence of recurrent inappropriate weight control behaviors and therefore often associated with obesity; and eating disorder not otherwise specified (EDNOS), an ill-defined category that includes more than 50% of cases in the community, and in ED treatment clinics. In adolescent and young adult women, lifetime prevalence rates have been estimated at 0.3%-0.9% for AN, 1%-2% for BN, 3.5% for BED, and up to 10% for EDNOS. Among young males, lifetime prevalence estimates are 0.3% for AN, 0.5% for BN, and 2.0% for BED. EDs have one of the highest rates of medical complications of any psychiatric disorder, including growth retardation, osteoporosis, gastrointestinal bleeding, dehydratation, electrolyte imbalance, cardiac arrest, and infertility. EDs are also frequently associated with other psychopathology and severe life impairment. Whether due to medical complications or the frequency of suicide, standardized mortality rates in AN are the highest of any psychiatric disorder, and are 12 times higher than the annual death rate from all causes in females 15-24 years of age. The pivotal effect of EDs on the health of youth and their families has led to their inclusion among the priority mental illnesses for children and adolescents identified by the World Health Organization. A recent position paper by the Academy of Eating Disorders also posits that AN and BN, along with their variants, are biologically-based serious mental illnesses that warrant the same level and breadth of health care coverage as conditions currently categorized in this way (e.g., schizophrenia, bipolar disorder, depression, obsessive-compulsive disorder).

Meanwhile, overweight and obesity have become the primary youth health problem in developed nations. In Canadian youth, the prevalence of overweight and obesity has increased between 1981 and 1996, from 11% to 33% in boys, and from 13% to 27% in girls; from 2003 to 2009, rates have continued to grow, despite an overall leveling off of the obesity epidemic in other countries. In a review of short-term consequences of pediatric obesity, psychological morbidity was found to be the most widespread health impact: obese children are more likely to experience psychological or psychiatric problems than non-obese children, girls are at greater risk than boys, and risk of psychiatric morbidity increases with age. Other short-term risks of pediatric obesity are
include cardiovascular problems, asthma, diabetes, insulin resistance, and low grade systemic inflammation.\textsuperscript{31,35} Long-term consequences of obesity in adolescence include persistence of obesity into adulthood in about 80% of cases,\textsuperscript{10-13} adverse social and medical outcomes in adulthood, and increased mortality.\textsuperscript{35-37} Obesity in adolescents and its co-morbid psychological and medical conditions represents a huge economic burden, with an annual cost in Ontario of $2.35 billion dollars, accounting for 5.3% of the provincial health care budget.\textsuperscript{38}

Surprisingly, it is only in the past decade that the commonalities between eating and weight disorders have been recognized. Until recently, the etiological and treatment models for EDs and obesity have had different theoretical foundations, leading to polarized research agendas and conflicting messages for the public. New research suggests that weight preoccupations, obesity, binge eating, dieting, and purging, all are weight-related problems that may co-occur in an individual, and that individuals may transition from one problem to another.\textsuperscript{39} Indeed, the co-occurrence of EDs and obesity is on the rise. An Australian study\textsuperscript{40} showed that, between 1995 and 2005, the population prevalence of co-morbid obesity and ED behaviors in individuals aged 15 and over had increased from 1% to 3.5%. This increase was higher than the prevalence increase for either obesity or ED behaviors alone. These and related findings have prompted researchers in the field of EDs and obesity to propose an integrated approach that would address the whole spectrum of eating- and weight-related problems.\textsuperscript{39;41-45} There is now a growing recognition that both categories of disorders should be conceptualized within a shared theoretical framework.\textsuperscript{39;44;45;46} It has been suggested that only an integrated approach to the prevention of disordered eating and obesity could be successful.\textsuperscript{39;42;43;47}

2. Current etiopathological models

The origins of both eating and weight disturbances are widely seen as a complex combination of biological, temperamental and environmental factors.\textsuperscript{48-51} Indeed, when reviewing the distinct literatures on EDs and obesity, striking similarities emerge. More than 30 variables from diverse theoretical perspectives (including genetic, biological, developmental, psychological, familial, social, cultural) have been reported as putative risk factors for both EDs\textsuperscript{15;52;53} and obesity.\textsuperscript{54-58} However, the empirical evidence for contributing factors varies from very strong to very weak; few of the proposed risk factors have been identified as significant in multiple samples; many studies have focused on a small number of potential risk factors; and the relative importance of different biological, familial, and psychosocial factors in predicting ED onset or obesity remains unclear.\textsuperscript{52;57;58}

2.1. Etiopathological models for eating disorders

A two-component model of EDs was first proposed by Garner et al.,\textsuperscript{59} distinguishing two classes of causal agents: one relating to eating-specific aspects of the disturbance, the other to more generalized vulnerabilities, psychopathology or maladaptation. Halmi and others emphasized that (i) the EDs, notably BN, generally developed after the stress of dieting,\textsuperscript{60;61} and (ii) the dieting experience was influenced by antecedent conditions that included genetic and physiological predispositions but was also affected by family and societal influences.\textsuperscript{52-54} Fairburn et al.\textsuperscript{53;55} conducted a community-based study comparing ED subjects to both normal and general psychiatric controls on three ‘domains’ of risk factors: personal vulnerability, environmental factors and dieting vulnerability. A dose-response effect was shown: the higher the degree of risk exposure, the higher the risk of developing an ED.\textsuperscript{64} Thompson et al.\textsuperscript{66} introduced a tripartite
influence model, viewing three primary environmental variables as the basis for development of body image and eating dysfunction: peers, parents and media. Thompson et al. also provide support for the influence of teasing on body image above and beyond the influence of overweight, and evidence that the relationship between body image and bulimic symptoms is mediated by restricting food intake. The tripartite influence model of disordered eating was further examined by Van Den Berg et al. The findings highlighted that appearance comparisons mediated the effects of family and media influences on body dissatisfaction, which in turn influenced restrictive and bulimic behaviors. Stice et al. evaluated the theoretical components of a dual-pathway model of EDs, and found that societal pressures to be thin and the internalization of such pressures were linked to body dissatisfaction; in turn, body dissatisfaction mediated pathways to unhealthy dieting behaviours, negative affect and bulimic symptoms. Steiger placed special emphasis on the exacerbation of constitutional (genetic) vulnerabilities by developmental experiences and current stressors, as well as the activation of latent susceptibilities by the effects of caloric deprivation and excessive dieting.

2.2. Etiopathological models for obesity

Etiopathological models for obesity in youth have emphasized both biological/genetic contributions to eating and weight regulation, and societal/environmental influences on diet and physical activity. Most current models conceptualize a predisposition to obesity (influenced by numerous susceptibility genes accounting for variations in energy requirements and taste preference), and three major factors that increase or reduce the likelihood of weight disorders: metabolic factors, diet, and physical activity. In view of its rapid development in genetically stable populations, the current pediatric obesity epidemic is generally attributed to adverse environmental factors, accompanying changes in the lifestyle of populations that have occurred in the second half of the 20th century. The two main features of the current obesogenic environment (“the big two”) are thought to be food marketing practices (increased portion sizes, inexpensive food sources such as fast food, vending machines with energy-dense items, etc.) and institutionally-driven reductions in physical activity (less physical education in schools and during leisure time, decreased walking in the built environment).

New evidence has recently emerged for additional, and sometimes modifiable, environmental factors including microorganisms, increasing maternal age, assortative mating, sleep debt, pharmaceutical iatrogenesis, reduction in variability of ambient temperatures, and intergenerational effects. However, measurement of the ‘environment’ in many studies has been rather narrow, and does not reflect a broad spectrum of psychological, familial and interpersonal variables likely to influence eating and weight regulation in youth.

3. Previous community-based prospective longitudinal studies

3.1. Cohort studies on risk factors for eating disorders

More than 50 published longitudinal studies have examined risk factors for EDs (e.g., in 2008-2009, Pike et al., Field et al., and Allen et al). At baseline, participants were between 11 and 15 years old in most studies, and half of the studies used samples of girls only. Sample sizes ranged from 92 to 2,992 participants, and follow-up periods from 6 weeks to 20 years. Eating symptoms were generally assessed using cut-off scores on questionnaires, and less often using structured diagnostic interviews. The majority of investigators followed their entire sample, while a few reassessed only the high-risk participants. Attrition rate over time ranged from 9% to 48%. The risk factors identified
varied from factors directly related to disordered eating, such as dieting, abnormal eating behavior and/or attitudes, weight concerns, body dissatisfaction, body image, dietary restraint and childhood eating problems, to more psychologically pervasive factors such as self-esteem, negative affect, ineffective coping style, self hate, and neuroticism. The environmental factors implicated included perceived family dysfunction, teasing, unpopularity, social pressure, poverty, divorce, as well as more traumatic experiences of physical neglect or sexual abuse. Several studies pointed to a relationship between EDs and antecedent high body mass index (BMI), or pubertal weight and height spurt. Several fixed markers were investigated (personality, birth order, number of siblings, family background); only race and temperament were associated with pathological eating.

3.2. Cohort studies on risk factors for obesity

Numerous longitudinal studies have explored predictors of obesity in adolescence or early adulthood (e.g., Hesketh et al., Richardson et al.) Sample sizes ranged from 16 to 14,972 participants, and follow-up periods, from 1 to 15 years. In all studies, obesity was assessed using BMI (weight in kilograms divided by squared height in meters) and BMI percentiles based on well-normed height-weight growth charts. Most investigators conducted follow-up assessments with the entire sample, whereas few only assessed at follow-up the initially non-obese participants. Attrition rates ranged from 0% to 63%. Overall, the risk factors/predictors of obesity in adolescents included elevated dietary restraint scores, binge eating, exercising to control weight, use of other compensatory behaviors (i.e., laxatives, vomiting), baseline BMI, parental obesity, pubertal increase in fat free mass and fat mass, physical inactivity (TV viewing, playing video games, not playing sports), depression and depressive symptoms, conduct disorder symptoms, frequency of meals taken out of the home, and maternal smoking during pregnancy.

3.3. Cohort studies on risk factors for obesity and disordered eating

To our knowledge, there have only been two prospective longitudinal studies investigating an integrative model of risk for adolescent EDs and obesity together, the Eating Among Teens (EAT) study, and the Growing Up Today (GUTS) study, both conducted in the USA. In the EAT study, longitudinal associations between socioenvironmental factors, personal factors, behavioral factors, and three outcome variables (i.e., overweight, binge eating, extreme weight control) were investigated over a 5-year interval in middle and high school students. Results supported the utility of a joint model to predict obesity and disordered eating outcomes. In girls, socioenvironmental (maternal weight concern, weight teasing, and exposure to media), personal (body dissatisfaction, weight concern, self-esteem) and behavioral variables (weight control practices and eating patterns) were predictive of all three outcomes. In boys, fewer predictors of outcomes were found; however a similar pattern to girls was demonstrated: maternal weight concern/behavior, personal weight concern, weight status, dieting, and unhealthy and extreme weight control behaviors were strong predictors of each of the three outcomes. The results also indicated significant increases in the use of unhealthy weight control behaviors between middle and late adolescence. In the GUTS study, there were also three outcome variables: overweight, use of laxatives or purging (vomiting), and binge eating. Concern with weight was directly associated with the initiation of all three weight-related problems over a 2-year period among boys and girls. Among girls, dieting, parental weight-related teasing,
and family meal frequency also had a shared effect on the weight-related problems examined.\textsuperscript{131} 

The EAT and GUTS studies have recently provided rich longitudinal data on the effects of selected risk factors on both disordered eating and overweight in adolescents. Exciting findings have emerged that have raised much interest in the scientific community, as attested by numerous publications in a variety of journals. The overall aims of our program of research, the Ontario Research on Eating and Adolescent Lifestyles (\textit{REAL} study) are to extend the depth and reliability of previous findings and answer additional research questions. In the EAT and GUTS studies, the ED outcome variables are single items (e.g., binge eating defined as ‘having at least 1 episode of overeating in the past year and feeling out of control during the episode’) while our outcome measure for EDs (EDDS,\textsuperscript{133} see below) provides both diagnostic categories of full- and partial-syndromes of EDs, and a dimensional score reflecting severity and frequency of disordered eating behaviors. Similarly, the breadth of predictor variables in the \textit{REAL} study is much larger, and all are measured using validated and reliable rating scales (e.g., the SATAQ,\textsuperscript{134} see below, with gender-specific questions and validated subscales, rather than single-item question on ‘desire to look like same-sex figures’).

The EAT study examined associations between risk factors and outcome variables in separate models, and the GUTS study looked at both homogeneous and different effects on three weight-related outcomes. However, both studies mainly approached the predicting variables in isolation, while in the \textit{REAL} study we are testing putative risk factors simultaneously within an integrated model. Our weight categories are internationally-based, sex- and age-specific, and compatible from adolescence to adulthood. We are not aware of previous studies including in their outcome measures both thinness and overweight/obese weight categories.

4. The \textit{REAL} study (\textit{Research on Eating and Adolescent Lifestyles})

4.1. Overall goal and conceptual model

Building on previous findings regarding risk and protective factors for EDs\textsuperscript{15,52,53,76} and/or obesity in adolescents,\textsuperscript{54-58} we aim to identify cross-sectional and prospective predictors of both eating and weight disorders in a large population-based sample of Canadian adolescents. Potential predictor variables were categorized into four broad risk factor domains: biological, socioenvironmental, psychological, and behavioral. The \textit{REAL} study is guided by an integrated biopsychosocial theoretical framework (see Figure 1) designed to replicate established predictors of both EDs and obesity, as well as highlight new relationships between variables in order to inform the development of an integrated prevention approach. The model is multi-theoretical in that it integrates biological vulnerabilities with several psychosocial theories of eating and weight disorders, including social-cognitive, cognitive-behavioural, interpersonal and family systems theories.

4.2. Objectives of the current study

The primary objectives of this prospective longitudinal school-based study were: (1) to investigate the biological, environmental, and individual factors that contribute to body image, eating behaviours, and body weight in adolescent boys and girls; (2) to test a developmental biopsychosocial model integrating the above factors to predict healthy or unhealthy eating and weight in adolescent boys and girls.

It was hypothesized (see Figure 1) that (i) the influence of biological variables (i.e., sex, family history of weight and eating disorders, weight status during childhood, age at
puberty) and environmental variables (i.e., family context, societal influences, stressors and life events) on body image in youth, are mediated by individual factors (i.e., self-perception, interpersonal functioning, emotional regulation and coping); (ii) poor body image predicts disordered eating and unhealthy weight via the practice of dietary restraint and/or emotional eating; (iii) biological vulnerabilities also have a direct effect on body image, emotional eating and dietary restraint; (iv) certain factors (e.g., internalization of societal pressures to be thin and interpersonal functioning) will have a stronger impact on the outcome variables in girls than in boys; and (v) though the pathways to disordered eating and obesity will be similar, the relative weight of various determinants will differ between the two types of disorders (e.g., biological vulnerabilities having a stronger impact on weight disorders, and psychological variables a stronger impact on EDs).

Secondary Objective: Throughout the course of the research grant, the participating schools benefitted from a targeted prevention, which was built into the research project (see “Safety protocol” in Appendix A). Every student who completed the survey questionnaire was screened for high risk scores on a suicide item, and on ED and depression scales. The screening was designed to ensure early identification of students with acute mental health problems, and facilitate access to services for those in need.
1. Participants

In order to access a large sample of adolescents from diversified sociodemographic backgrounds, a research agreement was established with three School Boards (Ottawa-Carleton District and Catholic School Boards, and Upper Canada District School Board) in 2005 and renewed annually. As per this agreement, all schools within each School Board were informed about the research and offered to participate on a voluntary basis. A total of 26 public schools, located in urban, suburban and rural areas consented to participate. In addition, a few private schools were approached, and two provided participants. Within each school, the researchers were allowed to recruit in one or several classrooms designated by the principal or specific teachers based on feasibility. Students were informed about the study and offered to participate in the baseline (Y0) survey, after they provided personal and parental written consent (total in the cross-sectional sample: N=2827). In addition, participants in Grade 7 or Grade 9 (and their parents) were asked to provide written consent and contact information in order to be recontacted by the research team a year later. A total of 1172 (85.8%) of Grade 7 or Grade 9 students who completed the baseline survey provided consent to be recontacted, and form the longitudinal cohort. Of those: 470 (40%) are boys, and 702 (60%) are girls; 685 (58.4%) were in Grade 7 (mean age ± SD = 12.6 ± 0.4 years), and 487 (41.6%) were in Grade 9 at baseline (mean age ± SD = 14.7 ± 0.4 years).

2. Procedure

At baseline and each subsequent year thereafter (±3 months from the baseline date), the researchers visited each participating school twice, once to distribute consent forms to be signed by students and their parents, and once to supervise students to complete a questionnaire (completion time, about 1 hour) and collect objective measures of weight and height, during regularly scheduled class time. Year 1 (Y1) and Year 2 (Y2) follow-up assessments were done in the students’ schools whenever possible. Alternatively, participants were contacted individually by phone and/or email, and offered to complete the survey at their convenience in the Institute of Mental Health Research (IMHR) Youth Research Unit or another location. Assessment time was arranged individually with each participant, and could be scheduled in the evening or on weekends, as to accommodate the participant’s schedule and parent’s transportation when needed. Upon completion of the questionnaire at school or in the Research Unit, a research assistant measured participants’ height and weight in a private space. For some participants living in distant neighbourhoods, we also made arrangements to organize survey completion for small groups in local community centers. Participants completing the survey in their schools had their name entered into a lottery for a gift worth $120 with 1:20 odds of winning, or received a pizza party per classroom. If students completed the survey at another location, they were offered $20 or 2 high school volunteer hours as compensation for their time and participation.

A safety protocol (see Appendix A) was put in place, in accordance with Research Ethics requirements, at initiation of the REAL study. Those participants identified as possibly suicidal (on item #9 of the Child Depression Inventory-CDI) or scoring above a clinical cutoff on scales for depression (CDI) or eating disorders (EDDS, see below) were identified, and a clinician from the team, or an assistant under his/her supervision, reviewed the participant’s scores and contacted him/her by telephone within 72 hours (for suicidal ideation), or within two weeks (in other cases). The clinician determined the
participant’s safety and provided, as required, an action plan to ensure that the youth would receive proper psychological and/or environmental support (this included a telephone contact with a parent when deemed necessary), crisis intervention, or follow-up referral.

3. Assessment measures

The survey questionnaire was the same at each yearly assessment, and included a package of self-report instruments validated for use with adolescents (see Appendix B for description and psychometric properties of selected instruments).

3.1. Predictor variables

Following from our conceptual model, we identified constructs for the hypothesized risk factors for eating and weight disorders in youth, and selected existing validated and reliable self-report questionnaires to measure the proposed constructs. One additional instrument was constructed for the study, the Attitudes and Patterns of Eating (APE) questionnaire and is currently being validated (Quirk-Baillot et al, submitted).

Biological vulnerabilities. A limited number of ‘biological’ factors can be assessed through self-report. We included: sex; the Pubertal Development Scale (PDS);\textsuperscript{135,136} biological father’s and biological mother’s weight status using a series of standardized silhouettes (Stunkard scores) from the McKnight Risk Factor Survey-IV (MRFS);\textsuperscript{92,137} similar series that we designed of standardized silhouettes for participant’s weight status during childhood; and the family history of ED subscale from the MRFS.

Family Context. In addition to questions on ethnic background of the family and parental education, we used the Family Adaptability and Cohesion Scale II (FACES);\textsuperscript{138} the homemade meals and other questions on family eating habits from the APE questionnaire; and the parent concern with thinness, mother diets, and weight teasing (parents) subscales from the MRFS.

Societal Influences. These were assessed using the Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ);\textsuperscript{134} the Beliefs About Appearance Scale (BAAS);\textsuperscript{139} the Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA);\textsuperscript{140} and the weight teasing (peers, adults) subscale from the MRFS.

Stressors and life events. Information came from the Perceived Stress Scale (PSS);\textsuperscript{141} and the life events, safety, sexual pressure and medical problems subscales from the MRFS.

Interpersonal functioning. Measures included the Adolescent Relationship Questionnaire (ARQ);\textsuperscript{142} the Silencing The Self Scale for Adolescents (STSS-A);\textsuperscript{143} and the social group, dating and support subscales from the MRFS.

Self-perception. This construct was measured by the perfectionism and confidence subscales from the MRFS; and the Child Depression Inventory (CDI).\textsuperscript{144,145}

Emotional regulation and coping. A variety of measures were used, including the trait anger and anger expression subscales from the State Trait Anger Expression Inventory (S-TAXI);\textsuperscript{146} the Multidimensional Anxiety Scale for Children-10 items (MASC-10);\textsuperscript{147,148} the Coping Inventory for Stressful Situations (CISS);\textsuperscript{149,150} the activities that make you feel good, sport, healthy behaviours, and physical health symptoms from the MRFS; Godin Leisure-Time Exercise Questionnaire;\textsuperscript{151} and the Leisure-Time Sedentary Activities Questionnaire.\textsuperscript{152}
Body image. We used the Body Esteem Scale for Adolescents and Adults (BESAA),\textsuperscript{153,154} and the appearance appraisal subscale from the MRFS.

Dietary restraint. This construct was measured on the dietary restraint subscale from the Dutch Eating Behavior Questionnaire (DEBQ),\textsuperscript{155} and the eating diet food subscale from the APE questionnaire.

Emotional eating. This was assessed using the emotional eating subscale from DEBQ.

3.2. Outcome variables

The two outcome variables were eating and weight disorders.

Participants were classified into three eating disorder categories using the Eating Disorders Diagnostic Scale (EDDS),\textsuperscript{133} which allows for the diagnosing of EDs using DSM-IV criteria for AN, BN, or BED, and Keel et al (2005)\textsuperscript{156} criteria for EDNOS purging type (overrevaluation of weight and shape associated with purging behaviours twice a week or more). The EDDS also permits the use of the anticipated DSM-V criteria for EDs (www.dsm5.org).

(1) Full-syndrome ED: based on Allen et al (2009)\textsuperscript{76} study, the expected prevalence of DSM-IV ED is 3%. By using less stringent criteria (e.g., lowering the frequency criteria for binging eating and compensatory behaviors), the DSM-V will lead to increased prevalence figures.

(2) Partial-syndrome ED: this included participants meeting subthreshold criteria for AN, BN, BED, or EDNOS purging type, as defined by Allen et al (2009);\textsuperscript{76} in their study, the prevalence of partial syndromes of ED was 3%.

(3) No disordered eating: this included participants who did not meet the above criteria for either full- or partial-syndrome of any ED.

Participants were also classified into five weight categories according to the age- and sex- specific BMI percentiles defined by the International Obesity Task Force (IOTF) using data from six national studies conducted in different countries.\textsuperscript{157,158} Obesity is defined as BMI >= 95\textsuperscript{th} percentile, overweight as BMI >= 85 to <95\textsuperscript{th} percentile, normal weight as BMI >= 16 to <85\textsuperscript{th} percentile, thinness grade 1 as BMI >= 3\textsuperscript{rd} - to 16\textsuperscript{th} percentile, and thinness grade 2 as BMI < 3\textsuperscript{rd} percentile. These cut-offs are based on centile curves drawn to pass at age 18-year through the widely used cut-off points of 30 kg/m\textsuperscript{2} for obesity, 25 kg/m\textsuperscript{2} for overweight, 18.5 kg/m\textsuperscript{2} for thinness grade 1, and 17 kg/m\textsuperscript{2} for thinness grade 2. For adolescents older than 18, the latter values were used. The IOTF cutoff points are considered as the most useful definition of weight disorders in adolescents,\textsuperscript{1} and provide comparability in assessing weight categories in adolescents and adults.

Both the BMI value and the EDDS total composite score\textsuperscript{133} can also be used as continuous variables.

4. Limitations

There have been several limitations and challenges to data collection. The nature of this study required a fairly large time commitment from the schools, both for staff and students. It may be for this reason that some schools declined participation in the baseline survey, or denied researchers access through the school to longitudinal participants in the following years. However, many schools welcomed the research team for yearly reassessment, and we have created a good working relationship, still ongoing, with many of the school boards and private schools in the Greater Ottawa area.
The overall culture of each school, as well as particular interest in the study from the school principal or other school staff involved in implementation of the study, have also resulted in widely divergent rates of students’ participation to the baseline survey from one school to another (5% to 83%). In order to reduce these effects, the research team put in place over the years many incentives for schools and students to encourage participation; the overall participation rate to the baseline survey has been 45%.

When re-contacting longitudinal participants, it was at times difficult to reach students, as the school may not have had an interest in participating in the study that year, or participants may have changed schools or moved to a different address. A lot of effort was made by research staff to ensure longitudinal surveys were completed (see below, year to year participation rates). When participants were unable to complete longitudinal questionnaires with other students from their school, research staff made every effort to reach them individually by phone or e-mail, and to have them complete the survey at another time in their school, at a community centre, or at the IMHR Youth Unit.

Another limitation was inherent to the ethical requirement that active parental consent (consent form signed by a parent and returned to the research team by the participant) was obtained before any participants could complete their annual survey. The use of active parental consent (a requirement from most Ethics Boards for studies done with adolescents) appeared as the major barrier to student participation, as is the case in other studies of this kind: in school-based surveys, between 30% and 60% of parents fail to respond to mailed or student-delivered active consent forms. In the end, although the REAL study population was based on schools’ and students’ voluntary participation, figures for ethnicity and education in the study population at baseline were very close to those reported by Statistics Canada in the 2006 census of the Ottawa area, (see Table 1) thus confirming that we were successful in recruiting a wide diversity of participants.
Results

As outlined in the overall presentation of the REAL study (above) and the Next Steps section (below), our program of research is a long-term project including several research components (cross-sectional study, longitudinal study, English- and French-speaking samples, etc.), and overlapping stages of development, from study design, data collection, data analysis, and publication/presentation of study findings. During the tenure of the Center of Excellence grant, the major accomplishments have been the following:

1. Analysis and publication of results from the first wave of REAL data collection, i.e., the cross-sectional sample. (see below, Knowledge Exchange Plan, for list of publications and communications to date)

Several articles (4 published, 3 under review) have looked at components of the model as cross-sectional predictors of either disturbed eating behaviours or overweight/obesity in adolescents (see attached papers).

In brief:

- Clear relationships have emerged between body image and weight status, the highest degree of body dissatisfaction being seen in the obese youth, independently of age and gender. A relationship was found between dietary restraint and weight status, whereby higher restraint scores were associated with greater adiposity. The obese youth reported greater depressive symptoms, including anhedonia and negative self-esteem, than the overweight and normal-weight youth.\(^{162}\)

- We examined how ‘self-silencing’ (i.e., placing others’ needs before one’s own), emotional regulation, and body esteem differentiated girls with either restrained or emotional eating from those with healthy eating. The two disordered eating groups scored significantly higher on measures of self-silencing and anger regulation, and lower on body esteem. The emotional eaters reported higher levels of externalized self-perception and anger, and lower levels of body esteem than the restrained eaters. Body esteem and anger suppression were the most influential variables in differentiating between groups.\(^{163}\)

- A dose-response effect was observed between the intensity of physical activity and psychological adjustment, with youth performing greater bouts of physical activity exhibiting better psychological adjustment than those engaging in mild to moderate intensity activity. Gender impacted the results as vigorous physical activity was associated with reduced depression but not anxiety in boys, and reduced anxiety but not depression in girls.\(^{164}\)

- Weight-based teasing was reported by 33% of girls and 18% of boys, and was more frequent among overweight or obese youth than normal-weight youth (45% vs. 22%). Teasing about body weight was consistently associated with anxiety, psychological distress and disordered eating, and these associations held for both boys and girls, independently of weight status.\(^{165}\)

- It was shown that eating together as a family may be a protective factor against obesity in female adolescents but not in male adolescents, after controlling for potential confounding factors associated with BMI, such as parental education and adolescent’s age, and snack food eating. These findings have important implications for parents and
health care practitioners to advocate for regular family meals as part of a comprehensive obesity prevention and treatment program for female youth (Goldfield et al, in press).

- Articles currently under review or ready to be submitted address: the relationships between internalization of the ideal body figure and disordered eating (restrained, emotional and external eating), and the mediating effect of body esteem (Flament et al, under review); the role of coping as a significant partial mediator between stress and eating disorder symptomatology, regardless of gender or developmental stage (Henderson et al, to be submitted).

Two additional articles have examined the validity of new or adapted scales used in the REAL study. We constructed the Attitudes and Patterns of Eating (APE) questionnaire to assess family and individual ideas and attitudes towards food and eating. Five subscales have been identified: Diet food eating, Snack food eating, Homemade meals, Skipping meals, and Healthy eating (Quirk-Baillot et al, under review). We examined, in the study population, the psychometric properties of the Self-Silencing Scale for Adolescents, adapted from the adult version of the questionnaire. A 3-factor structure was confirmed, with satisfactory internal and convergent validity in both boys and girls (Buchholz et al, to be submitted).

One article has compared, in a subsample of the study population, measured versus self-reported weight and height. These anthropometric indices are used to calculate BMI and therefore weight categories. As in previous studies, weight was slightly under-reported (on average, by 1.39 kg). The extent of under-reporting weight was positively associated with measured BMI, and negatively associated with age and internalization of the ideal body figure. The self-reported measurements classified 3.0% as thin, 67.8% as normal-weight, 23.5% as overweight, and 5.6% as obese, versus objective measurements leading to 3.3%, 67.8%, 22.8%, and 6.1%, respectively. The kappa statistic measuring agreement between self-report and objective classifications was 0.69 (Flament et al, submitted).

Data analysis is ongoing on more components of the model, and preliminary results have been presented at local, national and international meetings (a total of 36 oral communications or poster presentations to date, see Knowledge Exchange Plan, below).

2. Yearly data collection from participants in the longitudinal cohort (N= 1172)

It should be noted that, since it took a few years to recruit the cross-sectional sample (from which the longitudinal sample is derived) and the REAL study is still ongoing, participants in the longitudinal study are currently at different stages of completion. The various stages include Y0 (baseline), Y1 F/U (first year of follow-up), Y2 F/U (second year of follow-up), Y3 F/U (third year of follow-up), and Y4 F/U (currently the final year in study). Those participants recruited at the beginning of implementation of the study (i.e., in 2006) have already completed Y4 F/U, while those in the last wave of baseline (Y0) assessment are still due for Y1 F/U.

Appendix C summarizes rates of consent and participation for participants in the longitudinal cohort due for their yearly assessment in any stage of the study.

Overall, at Y0, 83.9% of Grade 7 or Grade 9 students signed a consent form for follow-up; while 96.1% of Y1, 100% of Y2, and 100% of Y3 completers consented for further follow-up. Participation rates so far have been 60% from Y0 to Y1, and 49% from Y1 to Y2 F/U. Overall, of those participants who consented to follow-up in Y0, 90% have completed Y1 and/or Y2 follow-up (see Appendix C).
3. Multidisciplinary academic collaborations and researcher training potential

Along with the growing size of the REAL study population, and the multiple opportunities provided by the yearly assessment of an adolescent cohort, potentially up to early adulthood, our research project has attracted more and more researchers from various fields related to adolescent development and adolescent psychopathology who are joining as collaborators in the study, bringing novel and complementary research expertise to the core researcher team (see Next Steps, below).

Furthermore, many graduate and undergraduate students in psychology, biomedical sciences and psychiatry have been or are currently involved in the REAL study under the supervision of the researchers. Those students, some of whom will become future Canadian researchers, are being trained in all parts of the research process, including literature reviews, data collection, data analysis, and manuscript/communication preparation. While contributing to implementation of the research, they are given the opportunity to use part of the REAL database to examine, under supervision, some research questions of their choice, and complete academic requirements, including independent studies, honours, masters or doctoral thesis, or prepare and deliver oral or poster presentations at scientific meetings (see Knowledge Exchange Plan).
Conclusion and Future Directions

The REAL study (Research on Eating and Adolescent Lifestyles) has started as a cross-sectional study looking at correlates of eating and weight disorders in adolescents recruited in junior high schools and high schools from the greater Ottawa area. One innovative approach was to put in place a research team with a double expertise in pediatric ED and obesity research, and to conceptualize a project integrating previous evidence-based research from both the ED and the obesity fields (which at the time were being done in completely separate silos). We designed our theoretically-based conceptual model, including risk and protective factors for both eating and weight disorders in youth, identified the relevant constructs and selected validated and reliable self-report instruments to constitute a ~1-hour questionnaire to be used with grade 7-12 students, within their school setting.

- **Grant 1.** Correlates of eating and weight disorders in a community-based adolescent population: Investigating an integrative biopsychosocial model (PI: M. Flament; Co: K. Henderson, A. Buchholz, & G. Goldfield; Coll: G. McVey; T. Clifford), funded by: University of Ottawa Medical Research Fund (UMRF); $35,000; 2005-2007.

Once we got agreement from three school boards to collect data in a large number of their schools, the current grant from the Center of Excellence was aimed to (i) expand the cross-sectional sample (total N=2827), and (ii) select two cohorts of students initially in Grade 7 and Grade 9 to constitute a longitudinal sample to be followed yearly for 2 years (N=1172)

- **Grant 2.** Examining a biopsychosocial model of the development of body image, eating behaviours and weight in adolescents: An Ontario 2-year prospective longitudinal school-based study (PI: M. Flament; Co-PI: R. Flewelling; Co: A. Buchholz, K. Henderson, G. Goldfield, K. Matheson, & G. McVey), funded by: The Provincial Centre of Excellence for Child and Adolescent Mental Health at CHEO (CoE); $149,998; 2006-2009.

Meanwhile, in order to extend the diversity of our study population and make the study findings generalizable to Canadian youth of both English- and French-speaking background, we developed a French version of the study questionnaire and conducted a study exactly similar to that in the English-speaking schools within a sample of N=654 high school students from grade 9 to grade 12.


All REAL participants were initially recruited and surveyed in their schools. As the years of follow-up increased, participants started to be disseminated in different classrooms and different schools. To continue and reach the longitudinal cohort thus constituted, we developed a web-based (WEB) questionnaire that the participants could complete online, independently of the school setting.

- **Grant 4.** The Ontario Research on Eating and Adolescent Lifestyles (REAL) study: From paper-and-pencil to web-based survey (PI: M. Flament; Co: K. Henderson, A. Buchholz, G. Goldfield, & M. Taljaard), funded by: University of Ottawa Medical Research Fund (UMRF); $35,000; 2010-2011.
The WEB survey is now in place and ready to be pilot tested. To compare data obtained using this new medium to those collected using the paper-and-pencil (PAP) version, we recently received a grant to complete 2 pilot studies examining the validity and reliability of the WEB questionnaire.

- **Grant 5. The Ontario Research on Eating and Adolescent Lifestyles (REAL) study:** Validation of a web-based survey questionnaire (PI: K. Henderson; CoI: M. Flament, A. Buchholz, G. Goldfield, N. Barrowman, & B. Virley), funded by: Children’s Hospital of Eastern Ontario Research Institute (CHEO-RI); $ 26,999; 2011-2012.

Our next objective is to use this advanced technology to extend the existing longitudinal REAL study by an additional two years, i.e., a total of 5 years from baseline for all consenting participants, in order to capture in the follow-up period the time of peak incidence of EDs, and to reach an age when obesity and associated co-morbid features are likely to persist into adulthood and therefore continue to have their deleterious impact on further life trajectories. Thus, we will capture the data required to test our integrated model over 5 years of adolescent development up to early adulthood.

- **Grant 6 (submitted and reviewed). Risk factors for eating and weight disorders in adolescents: Extending the REAL study to five years (Research on Eating and Adolescent Lifestyles (PI: M. Flament; Col: A. Buchholz, G. Goldfield, G. Tasca,, K. Henderson, S. Maggi), submitted to: Canadian Institutes of Health Research (CIHR); $563,913; 2012-2015.

As the final step of our research program, we are aiming to develop an ED/obesity prevention program (“REAL Bodies”) based on the risk and resiliency factors uncovered through the theoretical model tested in the current study. The goal is to create a collaboration between ED and obesity experts in the provision of a proactive whole school prevention project targeting environmental change in the promotion of positive body image and healthy bodies in adolescents.
Knowledge Exchange

To date, four articles have been published and one is in press (see attached); four more are at different stages of submission or review in peer-reviewed journals.

ARTICLES IN PEER-REVIEWED JOURNALS


Findings from the REAL study have also been presented at many academic and community conferences and meetings (to date, 36 oral presentations or posters; see selected poster presentations attached).

SCIENTIFIC COMMUNICATIONS AT LOCAL, NATIONAL OR INTERNATIONAL CONFERENCES


Reference List


Ref Type: Report


47. Daníelsdóttir, S., Burgard, D., and Oliver-Pyatt, W. AED guidelines for childhood obesity prevention programs. Academy of Eating Disorders . 3-9-0090.

Ref Type: Electronic Citation


Ref Type: Conference Proceeding


150. Endler NS, Parker JD. *Coping Inventory for Stressful Situations (CISS)*. North Tonawanda: Multi-Health Systems; 1990.


Ref Type: Generic


Ref Type: Report


Ref Type: In Press
