A latent profile analysis of the typology of bulimic symptoms in an indigenous Pacific population: evidence of cross-cultural variation in phenomenology

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Background. Previous efforts to derive empirically based eating disorder (ED) typologies through latent structure modeling have been limited by the ethnic and cultural homogeneity of their study populations and their reliance on DSM-IV ED signs and symptoms as indicator variables.

Method. Ethnic Fijian schoolgirls ($n=523$) responded to a self-report battery assessing ED symptoms, herbal purgative use, co-morbid psychopathology, clinical impairment, cultural orientation, and peer influences. Participants who endorsed self-induced vomiting or herbal purgative use in the past 28 days ($n=222$) were included in a latent profile analysis (LPA) to identify unique subgroups of bulimic symptomatology.

Results. LPA identified a bulimia nervosa (BN)-like class ($n=86$) characterized by high rates of binge eating and self-induced vomiting, and a herbal purgative class ($n=136$) characterized primarily by the use of indigenous Fijian herbal purgatives. Both ED classes endorsed greater eating pathology and general psychopathology than non-purging participants, and the herbal purgative class endorsed greater clinical impairment than either the BN-like or non-purging participants. Cultural orientation did not differ between the two ED classes.

Conclusions. Including study populations typically under-represented in mental health research and broadening the scope of relevant signs and symptoms in latent structure models may increase the generalizability of ED nosological schemes to encompass greater cultural diversity.

Introduction

The clinical utility of the DSM-IV eating disorder (ED) classification system has been critiqued insofar as the residual category, ED not otherwise specified (EDNOS), is the most common ED diagnosis in clinical settings. In contrast to the diagnostic categories of anorexia nervosa (AN) and bulimia nervosa

(BN), EDNOS is phenomenologically heterogeneous (Thomas *et al.* 2009) and few clinical trials support relevant treatment strategies. As a result, the upcoming publication of DSM-V has inspired a wave of research on empirical approaches to reconsider optimal ED nosology. To date, 10 published studies (Sullivan *et al.* 1998; Bulik *et al.* 2000; Keel *et al.* 2004; Striegel-Moore *et al.* 2005, 2008; Wade *et al.* 2006; Duncan *et al.* 2007; Mitchell *et al.* 2007; Pinheiro *et al.* 2008; Eddy *et al.* 2009) have used latent class analysis (LCA) or latent profile analysis (LPA) to derive ED subtypes empirically based on the co-occurrence of attitudes and behaviors in symptomatic samples. These analyses have proved invaluable in highlighting the strengths and weaknesses of DSM-IV diagnoses. For example, although several LCA and LPA studies have

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confirmed the existence of latent classes resembling AN (Bulik *et al.* 2000; Keel *et al.* 2004) and BN (Sullivan *et al.* 1998; Bulik *et al.* 2000; Keel *et al.* 2004; Striegel-Moore *et al.* 2005; Pinheiro *et al.* 2008; Eddy *et al.* 2009), others have identified subgroups not yet recognized as formal diagnostic categories in DSM-IV, including binge-eating disorder (Bulik *et al.* 2000; Striegel-Moore *et al.* 2005; Mitchell *et al.* 2007; Pinheiro *et al.* 2008; Eddy *et al.* 2009), purging disorder (Striegel-Moore *et al.* 2005; Mitchell *et al.* 2007; Pinheiro *et al.* 2008), and night eating syndrome (Striegel-Moore *et al.* 2008).

The generalizability of previous LCA and LPA findings to populations under-represented in mental health research may be limited, however, by the demographic homogeneity of the study samples. Specifically, only three studies have included participants from outside the USA, including Canada (Keel *et al.* 2004), Europe (Keel *et al.* 2004; Pinheiro *et al.* 2008) and Australia (Wade *et al.* 2006), and only one study has included a large proportion of non-Caucasian participants (Striegel-Moore *et al.* 2005). To date, no LCA or LPA studies have investigated the latent structure of eating pathology among participants outside high-income countries. This lack of broad ethnic, social and cultural representation is consistent with meta-trends in the broader psychiatric literature, in which just 6% of articles published in the field's top journals originate from the global regions outside of Western Europe, the USA, Australia or New Zealand that represent more than 90% of the world's population (Patel & Sumathipala, 2001).

Designated a priority area for adolescent mental health by the World Health Organization (WHO, 2003), EDs have global distribution and public health significance. Because eating pathology may present differently outside of the USA and Europe, empirical typologies derived from previous ED LCA and LPA studies may not capture the full range of possible presentations. For example, epidemiological and case-finding investigations have found AN to be rare among majority Blacks in Curaçao (Hoek *et al.* 2005), Kenya (Njenga & Kangethe, 2004) and Ghana (Bennett *et al.* 2004). However, a non-fat-phobic variant of AN has been identified in Hong Kong (Lee *et al.* 2001), Singapore (Ong *et al.* 1982) and Ghana (Bennett *et al.* 2004). Of note, although two LCA studies (Bulik *et al.* 2000; Keel *et al.* 2004) have identified latent classes resembling AN, and five LCA and LPA studies have identified subgroups of low- to normal-weight participants exhibiting moderate weight concerns (Bulik *et al.* 2000; Keel *et al.* 2004; Wade *et al.* 2006; Mitchell *et al.* 2007; Eddy *et al.* 2009), none has identified a class clearly resembling non-fat-phobic AN. This pattern of findings is consistent with etiologic theories that link the core psychopathology of eating disorders (i.e.

weight and shape concerns) to specific cultural and historical contexts (Lee *et al.* 2001; Becker *et al.* 2009).

The purpose of the present study was to conduct an LPA of ED phenotypes in an ethnic Fijian study sample to examine potential ethnic and cultural variation in optimal categorization. Ethnic Fijians, a small-scale indigenous Pacific Islander population, are ethnically and culturally distinct from Western populations used in previous LCA studies. Although there is no indigenous Fijian nosologic category for EDs, weight management strategies are common among Fijian youth (McCabe *et al.* 2009), and ethnic Fijian cultural traditions support attention to appetite, eating and body size (Becker, 1995; Mavoa & McCabe, 2008). However, in the setting of globalizing economic and cultural influences on the nutritional environment (Hughes & Lawrence, 2005), urban migration, and social norms for appearance, eating pathology (Becker *et al.* 2002) and obesity (Becker *et al.* 2005; Mavoa & McCabe, 2008) have become more common in ethnic Fijian females. Weight management strategies include the use of an extensive traditional herbal pharmacopoeia (*dranu*) both to prevent weight loss (Becker, 1995) and to prevent weight gain (Becker *et al.* 2010*a*), and suggest the potential for cross-cultural plasticity in ED presentation.

Therefore, our primary hypothesis was that an LPA using both conventional DSM-IV and uniquely Fijian ED symptoms as indicators would identify novel and culture-specific subgroups with possibly greater local relevance than those identified in previous ED LCAs and LPAs. Our secondary hypothesis was that symptomatic latent classes would differ from asymptomatic classes on external validators including eating pathology, clinical impairment, and general psychopathology. Finally, a *post-hoc* aim was to explore whether symptomatic latent classes were associated with differential social and cultural characteristics.

Method

Sample characteristics

Ethnic Fijian schoolgirls (*n* = 523) enrolled in 12 secondary schools registered within one sector of the Fiji Ministry of Education participated in this study, which was part of a larger investigation on social transition and psychopathology risk. Girls aged 15 to 20 years were eligible for inclusion. All of the invited schools agreed to participate, and 71% of eligible students enrolled in the study. The participants' mean age was 16.67 (S.D. = 1.09) years, and their mean body mass index (BMI) was 23.96 (S.D. = 3.35) kg/m². The participants were evenly divided between rural (50%, *n* = 262) and peri-urban (50%, *n* = 261) locations. Less

than half (41%, $n=216$) lived in relative material affluence (i.e. operationalized as having household access to electricity, a gas stove, a refrigerator, and running water); the majority (59%, $n=307$) lived in relative material poverty (i.e. lacking one or more of these goods or services). Furthermore, 41% ($n=216$) reported having sometimes gone hungry in the past month because of insufficient food in the home.

Procedure

The study used data originally collected as part of a two-stage design described previously (Becker *et al.* 2010*a*,*b*). In brief, all participants completed a self-report battery at Stage 1. Assessments were offered in either English (the language of formal instruction) or the vernacular (Fijian) language. For LPA indicators, we drew from Stage 1 self-report and anthropometric data available for the full sample ($n=523$). Stage 2 interview data were available for a subsample ($n=215$) selected by eligibility criteria specified in a related study identifying symptomatic ($n=178$) and asymptomatic ($n=37$) groups (described in Becker *et al.* 2010*a*,*b*). The Partners Human Research Committee (PHRC), Harvard Medical School Human Subjects Committee, and Fiji National Research Ethical Review Committee approved the data collection. The PHRC approved the secondary data analyses.

Measures

Eating pathology

We assessed eating pathology with the Eating Disorder Examination Questionnaire (EDE-Q) version 5.2, adapted to include an item assessing herbal purgative use. The EDE-Q is a self-report measure evaluating the domains of Restraint, Eating Concern, Shape Concern, and Weight Concern (Fairburn & Beglin, 1994). All participants rated the frequency of ED symptoms over the past 28 days on a Likert scale ranging from 'no days' to 'every day.' Internal consistency, retest reliability and construct validity were adequate in our sample (Becker *et al.* 2010*b*).

Herbal purgative use

We evaluated herbal purgative use as a potential LPA indicator with the following item incorporated into the EDE-Q: 'Over the past 28 days, how many times have you taken traditional Fijian *dranu* to cause diarrhea, clean out your stomach, or suppress your appetite as a means of controlling your shape or weight?' We have previously reported that self-reported herbal purgative use was prevalent in our sample, and significantly associated with both eating pathology (Becker *et al.* 2010*b*) and eating-related clinical impairment (Becker *et al.* 2010*a*).

Evaluation of herbal purgative use to qualify it as a potential indicator of eating pathology

Because the phrasing of this single assessment item could conceivably encompass non-pathological (i.e. culturally sanctioned medicinal) use of *dranu*, we sought to ascertain that herbal purgative use was rationalized as a mode of weight management by at least some participants to justify its inclusion as an LPA indicator. To interrogate the rationales for herbal purgative use and confirm its local cultural relevance as a potential sign of eating pathology, we examined portions of Stage 2 interview transcripts from a convenience sample of 19 respondents who had endorsed this behavior on the EDE-Q. Transcripts were from a semi-structured interview based upon the EDE interview version 16.0 (Fairburn & Beglin, 1994) and adapted for this population by adding culturally and developmentally appropriate probe questions addressing the presence, motivation and context of herbal purgative use. Of the 19, 74% ($n=14$) confirmed using herbal purgatives specifically to influence their shape or weight, whereas 26% ($n=5$) exclusively provided rationales less clearly linked to, or even independent of, eating pathology, such as the alleviation of postprandial discomfort after overeating ($n=1$), the prevention of appetite loss ($n=2$) or the treatment of physical illness ($n=2$). Table 1 displays interview transcript excerpts from six participants who affirmed that their herbal purgative use was linked to weight management and purging, although some excerpts illustrate plural rationales. Indeed, herbal purgative use was compensatory for specific overeating episodes (e.g. cases 2, 3 and 4), in addition to non-compensatory, but still motivated by weight management goals (e.g. cases 1, 5 and 6). Notably, we found evidence that family members sometimes encouraged or enabled herbal purgative use (e.g. cases 1, 3, 4 and 6). Consistent with our study aim to encompass a broad range of behaviors that might reflect culture-specific variation in eating pathology, we conceptualized herbal purgative use as a possible ED symptom and used it as an indicator variable in our LPA.

BMI

BMI was calculated as weight (kg) divided by height (m²), using height and weight estimates generated from measured values at Stage 1. We measured weight with an electronic scale to the nearest 0.2 kg and height to the nearest millimeter with a portable stadiometer in light clothing without shoes. Weight estimates were corrected for clothing by subtracting 0.5 kg, and height estimates were rounded to the nearest centimeter.

Table 1. *Excerpted interview transcript data illustrating a rationale for herbal purgative use to compensate for episodes of overeating and/or control shape or weight among six study participants who self-reported herbal purgative use in the past 28 days*

Case no.	Frequency of herbal purgative use in past 28 days reported on the EDE-Q	Peri-urban school	Age (years)	BMI (kg/m²)	EDE-Q global score	Excerpts from participant responses following an initial probe item about herbal purgative use, e.g. 'Over the past four weeks, have you taken *dranu* as a means of controlling your shape or weight?'
1	1	No	18	24.14	2.48	'Yes, madam. [INT] […] It's [called] *kura*. [INT] […] [It causes] vomiting [INT] […] and sometimes I get diarrhea. [INT] […] It's, uh, Fijian medicine […] [My parents] think that, uh, inside their body can come out and have the body to lose weight. [INT: And they want you to lose weight?] Yes, ma'am.'
2	1	Yes	18	28.12	4.19	'Yes, I tried to vomit. [INT] I drank to my mom's, like, herbal medicine I don't know for a cough, and I just tried it to take care of things, and I just drank it and then I started feeling sick and started vomiting. [INT: Did you do it because you wanted to get rid of the food?] Yes. […] [INT: Did you do it after you felt like you had eaten too much, or did you just do it?] No, after I ate too much.'
3	2	Yes	16	23.93	3.08	'Yes, ma'am. [INT] […] Fijian *dranu*. [INT] […] My mother gave it to me [INT] […] so it, um, because my stomach, to clean it out. [INT: Why did you feel like you needed to clean your stomach?] Because I had a lot to, I ate a lot. [INT: So you ate a lot?] Yes ma'am. [INT: And you wanted to get rid of it? But not to change your shape or weight?] Yes. [INT: Or to stay the same?] Yes ma'am. [INT: Was it to stay the same shape and weight?] Yes ma'am.'
4	5	Yes	17	22.11	3.36	'Yes. [INT] A Fijian one. [INT] It was in liquid form [INT] from a plant. [INT] We usually drink it as a whole family [INT] […] to cut down on my eating habits and to lose weight. [INT] […] It cleans out my stomach and makes me go to the loo most of the time. [INT: Did you do this after you felt you had eaten too much, like those times we talked about, or did you do it when you weren't eating too much?] When I was eating too much [INT] […] so that all the unwanted stuff could come out and that you could lose weight, be fit and all.'
5	5	No	17	22.77	2.28	'Yeah. [INT] It was, uh, it was before, when my father told me that I was like overweight. […] I was, like, um, very, um, not satisfied with my weight, so I tried Fijian medicine [INT] […] I took it and I tried to like make me sick so that I could, uh, vomit and like […] [have] diarrhea […] so that it could wash out. […] [INT: This was to control your shape and weight?] Shape and weight. [INT: Because your father told you that you were too big?] Yeah, that's why I took it.'
6	28	Yes	18	24.82	3.24	'Yes. [INT] […] It was a liquid. [INT] My mother [gave it to me]. [INT] Um, she says it's for girls [INT] to clean the stomach from, uh, everything. [INT] […] It helps. [INT] It makes me go to the, use the toilet. [INT: And did you do this to lose weight, too? Did you use it to control your weight?] Yes. [INT] Sometimes I take it, like, every day. [INT] […] Just for keeping safe and, uh, control something, control anything that can happen. […] [INT: Do you also do it to lose weight?] Yes. [INT: To be slim?] Uh-hmm.'

BMI, Body mass index; EDE-Q, Eating Disorder Examination Questionnaire; *Dranu*, a generic term for indigenous Fijian medicinal herbal preparations; *kura*, a specific Fijian herbal preparation; [INT], interviewer question omitted; […], participant comment(s) and/or participant and interviewer comment(s) omitted.

Impairment and co-morbid psychopathology

The Clinical Impairment Assessment (CIA; Bohn *et al.* 2008) evaluates the extent to which ED symptoms negatively impact mood, cognitive functioning and relationships, with four-point response options ranging from 'not at all' to 'a lot'. The CIA was adapted and administered to Stage 2 participants ($n=215$) as a structured interview. Internal consistency was adequate in our sample (Becker *et al.* 2010*a*). The Center for Epidemiologic Studies Depression Scale (CES-D) is a self-report measure of depressive symptoms (e.g. low mood, hopelessness) over the past 7 days (Radloff, 1977) and was used to measure psychopathology that is often co-morbid with disordered eating. The items, which are scored on a four-point Likert scale ranging from <1 day to ⩾5 days, have been used successfully in non-Western adolescent populations (Ghubash *et al.* 2000; Yang *et al.* 2004). For the present study, participants received scores as long as they had responded to at least 90% of the CES-D items.

Cultural orientation

We assessed cultural orientation with composite measures derived from Likert items relating multiple dimensions of both Western/global and ethnic Fijian cultural orientation. Development, translation and psychometric evaluation of these measures is described elsewhere (Becker *et al.*, in press). For the present study, participants received scores as long they had answered at least 80% of the scale items.

Indigenous practices: kava *and* dranu *use*

As an additional proxy for traditional Fijian orientation, we queried the use of indigenous health and social practices. We evaluated use of *kava* (a ceremonial and social traditional beverage prepared from dried *Piper methysticum* root) in the past 30 days on a Likert scale ranging from 0 (no days) to 5 (every day). We also assessed whether participants had used traditional herbal medicine to prevent and/or treat an indigenous illness, *macake* (characterized by loss of appetite; see Becker, 1995), in the past month.

Peer eating pathology

We evaluated the perceived prevalence of peer eating pathology in participants' social networks by asking them to estimate the proportion of 'your five or so closest friends' who had engaged in dieting, fasting and vomiting/laxative abuse in the past 30 days on a four-point Likert scale ranging from 'none of them' to 'all of them'. These items exhibited 'moderate' test–retest reliability ($\kappa=0.41$ for dieting, $\kappa=0.48$ for fasting, $\kappa=0.53$ for vomiting/laxative use) (Landis & Koch, 1977).

LPA

LPA is a technique that uses maximum likelihood estimation to assign participants to mutually exclusive populations called latent classes. Classes are latent because membership is not observable directly, but instead can be inferred by evaluating the pattern of inter-correlations among indicator variables. The purpose of LPA is to identify the smallest number of classes that could account for these inter-correlations, thus minimizing the associations among indicator variables within each latent class and achieving a state of conditional independence. In contrast to LCA, which accepts only dichotomous indicator variables, LPA uses nominal, ordinal or continuous indicators.

Consistent with previous LCA and LPA studies using community samples (Sullivan *et al.* 1998; Bulik *et al.* 2000; Striegel-Moore *et al.* 2005), we included only symptomatic participants in our LPA to enhance statistical power to identify multiple pathological groups. Because the base rate of AN symptoms was fairly low in our sample (i.e. only 1% had a BMI <17.5 kg/m² and 4% endorsed amenorrhea on the EDE-Q), we restricted our LPA to symptoms characterizing a diagnosis of BN. Therefore, we included only those participants who self-reported vomiting or herbal purgative use in the past 28 days through the EDE-Q ($n=222$)[1]†. LPA indicator variables reflected the frequency of EDE-Q bulimic symptoms, with the addition of herbal purgative use. Because both symptom frequencies and Likert endorsement of our indicator variables were positively skewed, we transformed indicators into dichotomies or ordered categories based on natural breaks in the distributions. Our LPA indicator variables were as follows: (1) overvaluation of weight and shape ['not at all' (mean of EDE-Q overvaluation items <1), 'slightly' (mean of EDE-Q overvaluation items ⩾1, <3), 'moderately' to 'markedly' (mean of EDE-Q overvaluation items ⩾3)], (2) binge eating (0, 1–3, ⩾4 episodes), (3) vomiting (0 *v.* ⩾1 episode), (4) laxative use (0 *v.* ⩾1 episode), (5) fasting (0 *v.* ⩾1 episode), (6) driven exercise (0, 1–4, ⩾5 episodes) and (7) herbal purgative use (0 *v.* ⩾1 episode).

We conducted our LPA using Latent Gold 4.5 (Vermunt & Magidson, 2005). We evaluated conditional independence by identifying the class solution associated with the lowest values of the Bayesian information criterion (BIC) and the consistent Akaike information criterion (cAIC), and also the minimization of cross-classification probabilities. We

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† The notes appear at the end of the main text.

examined bivariate residuals (indices of the remaining correlations among indicator variables within latent classes) to ensure that none was greater than 5. Because no more than 2% of participants had missing values on any indicator variable, all 222 participants who endorsed self-induced vomiting or herbal purgative use in the past 28 days were submitted to LPA, and the remaining 301 participants served as a non-purging control group in subsequent validation analyses.

Validation analyses

We hypothesized that, if purging is a valid marker of psychopathology among ethnic Fijian girls, then the latent classes would score significantly higher than non-purging participants with regard to (1) eating pathology (EDE-Q); (2) clinical impairment associated with disordered eating symptoms (CIA); and (3) depressive symptoms (CES-D). Furthermore, given the potential confounding effect of impoverished food environment on the cross-cultural assessment of eating pathology (le Grange *et al*. 2004), we wanted to ensure that the classes did not differ from one another or from the non-purging group on the 1-month prevalence of hunger because of lack of food in the home. To evaluate these hypotheses, we conducted a series of ANOVAs and χ^2 tests. To reduce Type I error, we set α to 0.01 for each omnibus test. To follow up statistically significant F tests, we used Fisher's least significant difference (LSD) *post-hoc* comparisons. To follow up statistically significant omnibus χ^2 tests, we used a Bonferroni correction by dividing $\alpha = 0.05$ by the number of unique pair-wise comparisons. We conducted our validation analyses on SPSS version 16.0 (SPSS, 2007).

Post-hoc *class comparisons of potential etiological variables*

A third aim of the study was to generate hypotheses about the social and cultural characteristics that could provide insights into the potentially distinct etiologies of symptomatic latent classes. Therefore, we used *t* tests and χ^2 analyses to compare levels of cultural orientation, indigenous health practices, and peer eating pathology, across classes. We again set α to 0.01 to reduce Type I error, and conducted these *post-hoc* analyses on SPSS version 16.0 (SPSS, 2007).

Results

LPA

We evaluated models with one to five classes. To meet the assumptions of the LPA model, we allowed for the conditional dependence of three pair-wise

Table 2. *Prevalence of eating disorder (ED) symptom endorsement in the LPA-derived BN-like class and herbal purgative class*
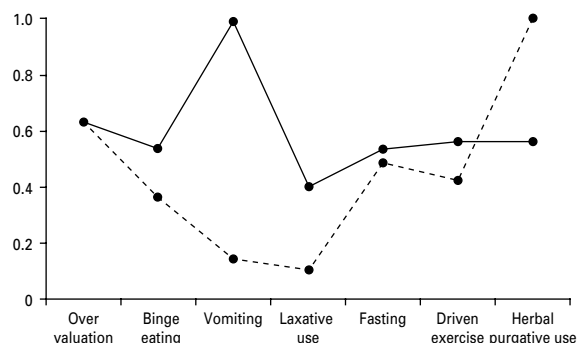
	BN-like (n = 86)	Herbal purgative (n = 136)
Overvaluation of weight and shape		
0 ('Not at all'/mean of EDE-Q overvaluation items <1)	8 (9)	21 (15)
1 ('Slightly'/mean of EDE-Q overvaluation items ⩾1, <3)	**48 (56)**	57 (42)
2 ('Moderately' to 'Markedly'/mean of EDE-Q overvaluation items ⩾3)	30 (35)	**58 (43)**
Binge eating		
0 (None)	9 (10)	57 (42)
1 (1–3 episodes)	**60 (70)**	**62 (46)**
2 (⩾4 episodes)	17 (20)	16 (12)
Self-induced vomiting		
0 (None)	0 (0)	**119 (89)**
1 (⩾1 episode)	**86 (100)**	15 (11)
Laxative use		
0 (None)	**51 (61)**	**121 (90)**
1 (⩾1 episode)	33 (39)	13 (10)
Fasting		
0 (None)	38 (44)	**72 (53)**
1 (⩾1 episode)	**48 (56)**	64 (47)
Driven exercise		
0 (None)	11 (13)	**53 (40)**
1 (1–4 episodes)	**51 (59)**	51 (39)
2 (⩾5 episodes)	24 (28)	28 (21)
Herbal purgative use		
0 (None)	36 (42)	0 (0)
1 (⩾1 episode)	**50 (58)**	**136 (100)**

LPA, Latent profile analysis; BN, bulimia nervosa; EDE-Q, Eating Disorder Examination Questionnaire.

Values given as *n* (%).

Within each cell, the bolded percentage indicates the modal response for that variable within that latent class. Numbers in some cells do not add up to the total number of participants in that latent class because of missing data on that variable.

correlations of indicators in which bivariate residuals were greater than 5: (1) herbal purgative use/laxative use; (2) driven exercise/overvaluation; and (3) laxative use/overvaluation. BIC and cAIC were lowest for the two-class model with 21 parameters (model fit indices available upon request from the first author)[2]. Table 2 displays the relative endorsement of each indicator variable in the two latent classes, and Fig. 1 provides a graphical depiction of these data.

Fig. 1. Relative endorsement of eating disorder (ED) symptom indicators in the bulimia nervosa (BN)-like class (——) and herbal purgative class (- - -). For the dichotomous variables (vomiting, laxative use, fasting and herbal purgative use), relative endorsement is plotted as the percentage of participants in each class who endorsed that symptom. For the ordinal variables (overvaluation, binge eating and driven exercise), relative endorsement is plotted as the mean of the three ordered categories (assigned point values of 0, 1 and 2 for increasingly greater frequencies) divided by 2, so as to fit on a 0–1 scale.

The first class comprised 39% ($n = 86$) of the purging sample and was characterized primarily by a high prevalence of self-induced vomiting (100%) and binge eating (90%). Members of this 'BN-like class' also had a moderate prevalence of herbal purgative use (58%) and laxative use (39%). In addition, the majority endorsed exercise for weight control (87%). Over half endorsed fasting (56%), and approximately one-third affirmed that weight and shape featured 'moderately' to 'markedly' in their self-evaluation (35%).

The second class comprised 61% of the purging sample ($n = 136$). All members of this 'herbal purgative class' endorsed herbal purgative use. Other forms of purging, such as vomiting (11%) and laxative use (10%), were endorsed infrequently. Participants defined by this class also endorsed binge eating (58%) and exercise for weight control (60%) less frequently than members of the BN-like class. However, the prevalences of fasting (47%) and 'moderate' to 'marked' overvaluation of shape and weight (43%) were comparable to those observed in the BN-like class. Notably, had we not added this culturally relevant item to the EDE-Q, 71% of participants in the herbal purgative class would have been classified as non-purging because of their negative responses to the items probing self-induced vomiting and laxative use.

Validation analyses

The results of the validation analyses are presented in Table 3; the p values in the following text represent

Fisher's LSD *post-hoc* pair-wise comparisons, which we conducted to follow-up omnibus tests that already met our $\alpha = 0.01$ criterion for statistical significance.

Eating pathology

Participants in the BN-like and herbal purgative classes endorsed similar levels of eating pathology on the EDE-Q. As hypothesized, the BN-like and herbal purgative classes both endorsed significantly greater EDE-Q Global, Restraint, Eating Concern, Shape Concern, and Weight Concern scale scores than the non-purging group (all p's < 0.05). The BN-like class, however, endorsed significantly greater Eating Concern compared with the herbal purgative class ($p = 0.03$).

Impairment and co-morbid psychopathology

Contrary to our expectations, the herbal purgative class endorsed significantly greater clinical impairment related to disordered eating than the BN-like class ($p = 0.03$), and the BN-like class did not differ from the non-purging group with regard to clinical impairment. In line with our predictions, the herbal purgative class endorsed greater clinical impairment than the non-purging group ($p < 0.001$). As expected, both the BN-like ($p = 0.005$) and herbal purgative ($p = 0.01$) classes reported higher levels of co-morbid depressive symptoms than the non-purging group.

Demographics

The classes two did not differ from one another or from the non-purging group on demographic characteristics, including age, BMI, peri-urban school location, relative material poverty, and hunger.

Post-hoc *class comparisons of potential etiological variables*

No significant sociodemographic or cultural differences were identified between BN-like and herbal purgative classes, including cultural orientation, indigenous practices or peer eating pathology (Table 4).

Discussion

To our knowledge, this study is the first LCA or LPA of ED symptoms in a small-scale indigenous population and outside a high-income country. Our LPA of ethnic Fijian schoolgirls identified two latent classes associated with comparable levels of eating and general psychopathology, which we have characterized as 'BN-like' and 'herbal purgative' classes, respectively. The BN-like class, with its high rates of binge eating

Table 3. *Comparison of external validators in the LPA-derived BN-like and herbal purgative classes versus the non-purging group*

	BN-like ($n=86$)	Herbal purgative ($n=136$)	Non-purging ($n=301$)	F(df) or χ^2(df)	p	Effect size
Eating pathology, mean (s.d.)						
EDE-Q Global	2.08 (0.93)[a]	1.90 (1.11)[a]	1.49 (1.05)[b]	$F(2, 519)=13.60$	<0.001	$\eta_P^2=0.050$
EDE-Q Restraint	1.28 (1.09)[a]	1.20 (1.24)[a]	0.71 (0.88)[b]	$F(2, 519)=16.39$	<0.001	$\eta_P^2=0.059$
EDE-Q Eating Concern	1.84 (1.01)[a]	1.51 (1.20)[b]	1.28 (1.09)[c]	$F(2, 519)=9.14$	<0.001	$\eta_P^2=0.034$
EDE-Q Shape Concern	2.62 (1.28)[a]	2.50 (1.45)[a]	2.09 (1.47)[b]	$F(2, 520)=6.77$	0.001	$\eta_P^2=0.025$
EDE-Q Weight Concern	2.55 (1.33)[a]	2.39 (1.39)[a]	1.90 (1.42)[b]	$F(2, 520)=10.18$	<0.001	$\eta_P^2=0.038$
Impairment and co-morbid psychopathology, mean (s.d.)						
CIA[d]	11.47 (10.43)[a]	15.39 (11.57)[b]	8.69 (10.15)[a]	$F(2, 212)=6.34$	0.002	$\eta_P^2=0.056$
CES-D	21.48 (7.14)[a]	20.85 (8.41)[a]	18.85 (7.25)[b]	$F(2, 514)=5.76$	0.003	$\eta_P^2=0.022$
Demographics						
Age (years), mean (s.d.)	16.70 (1.14)	16.74 (1.14)	16.65 (1.06)	$F(2, 520)=0.33$	N.S.	$\eta_P^2=0.001$
BMI, mean (s.d.)	24.03 (3.12)	24.11 (3.29)	23.88 (3.45)	$F(2, 520)=0.23$	N.S.	$\eta_P^2=0.001$
Peri-urban school location, n (%)	38 (44)	62 (46)	161 (54)	$\chi^2(2)=3.69$	N.S.	$V=0.08$
Relative material poverty, n (%)	54 (63)	79 (58)	174 (58)	$\chi^2(2)=0.71$	N.S.	$V=0.04$
Hunger due to insufficient food (past 30 days), n (%)	41 (48)	55 (41)	120 (40)	$\chi^2(2)=1.71$	N.S.	$V=0.06$

LPA, Latent profile analysis; BN, bulimia nervosa; EDE-Q, Eating Disorder Examination Questionnaire; CIA, Clinical Impairment Assessment; CES-D, Center for Epidemiologic Studies Depression Scale; BMI, body mass index; η_P^2, partial eta squared; V, Cramer's V; df, degrees of freedom; s.d., standard deviation; N.S., not significant.

[a, b, c] Means and percentages with different superscripts within each row differ significantly from one another (using Fisher's LSD *post-hoc* comparisons to follow up significant omnibus F tests, and Bonferroni corrections to follow up significant omnibus χ^2 tests).

[d] Data available for Stage 2 participants only ($n=215$).

Table 4. *Class comparisons of selected potential etiological variables in the LPA-derived BN-like and herbal purgative classes*

	BN-like ($n=86$)	Herbal purgative ($n=136$)	t(df) or χ^2(df)	p	Effect size
Cultural orientation, mean (s.d.)					
Global/Western orientation scale	4.54 (0.90)	4.44 (0.78)	$t(220)=0.88$	N.S.	$d=0.12$
Ethnic Fijian orientation scale	4.99 (1.48)	4.74 (1.58)	$t(220)=1.04$	N.S.	$d=0.16$
Indigenous health practices					
Kava use (Likert frequency in past month), mean (s.d.)	1.30 (0.51)	1.45 (0.62)	$t(220)=1.91$	N.S.	$d=0.25$
	1.74 (0.83)	1.63 (0.77)	$t(219)=1.05$	N.S.	$d=0.15$
Indigenous herbal medicine use to prevent *macake* (yes in past month), n (%)	44 (56)	73 (60)	$\chi^2(1)=0.34$	N.S.	$V=0.04$
Peer eating pathology: close friends, mean (s.d.)					
Dieting	1.99 (0.75)	1.93 (0.85)	$t(219)=0.49$	N.S.	$d=0.07$
Fasting	1.74 (0.83)	1.63 (0.77)	$t(219)=1.05$	N.S.	$d=0.15$
Vomiting/laxative use	1.48 (0.71)	1.32 (0.62)	$t(219)=1.69$	N.S.	$d=0.24$

LPA, Latent profile analysis; BN, bulimia nervosa; *Macake*, indigenous illness characterized by appetite loss; d, Cohen's d; V, Cramer's V; df, degrees of freedom; N.S., not significant.

and vomiting, is phenomenologically similar to the bulimic classes described in previous US and European LCAs and LPAs (Sullivan *et al.* 1998; Bulik *et al.* 2000; Keel *et al.* 2004; Striegel-Moore *et al.* 2005; Pinheiro *et al.* 2008; Eddy *et al.* 2009). By contrast, the herbal purgative class, which was characterized

primarily by the use of indigenous herbal purgatives, has not been observed in previous LCAs and LPAs, nor is it represented as a distinct subtype in DSM-IV. Although the two classes were distinguished by self-reported purging modalities, they seemed to share a core pathology by exhibiting remarkably similar profiles of eating and general psychopathology. Our results highlight the importance of including as LPA indicators locally meaningful behaviors that might be culture specific, such as herbal purgative use, to enhance the generalizability of empirically derived nosologic schemes.

Contrary to expectations, our *post-hoc* analyses of social and cultural characteristics did not find evidence that the herbal purgative class differed from the BN-like class on either Fijian or Western/global cultural orientation or perceived disordered eating among peers. However, our study was only sufficiently powered to detect medium to large effects. Moreover, the multiple dimensions of acculturation are likely to have heterogeneous impacts on health outcomes (Guarnaccia *et al.* 2009; Becker *et al.*, in press) and the two classes may differ on a facet of cultural orientation that we did not assess. An alternative interpretation is that ethnic Fijian girls view the two types of purging as interchangeable. Indeed, given that herbal purgatives are used to induce vomiting or diarrhea, it is conceivable that there is more overlap in purging modality than the self-report responses suggest, reflecting a response bias related to the perception that herbal purgative use is more socially acceptable than other modes of purging. It is also possible that within-class variation with respect to purging confounds the relationship between sociocultural variables and class membership. For example, the BN-like class contains respondents who also use herbal purgatives, and the herbal purgative class may include respondents who do not explicitly link their herbal purgative use to weight management, or who espouse plural rationales for herbal purgative use. Moreover, the herbal purgative class we identified may not be culturally unique; surveys of ED patients in the USA indicate that 13% (Trigazis *et al.* 2004) to 64% (Steffen *et al.* 2006) have used herbal products to induce weight loss or vomiting. Of these products, the ingestion of ipecac syrup to induce emesis in Western populations (Silber, 2005) bears some phenomenological similarity to the herbal purgative use observed in Fiji. Indeed, because no previous ED LCA or LPA has used ipecac or herbal product use as an indicator variable, we cannot be certain whether the emergence of a herbal purgative class in our ethnic Fijian sample reflects actual culture-specific phenomenologic heterogeneity or our more inclusive operational definition of disordered eating behaviors.

The substantial prevalence of herbal purgative use in our sample suggests local vulnerability to disordered eating that could benefit from additional research attention and clinical resources. However, there are several additional implications of our findings, beyond their immediate public health relevance for the local populace. First, these results suggest that the application of a 'universal' criteria set for EDs developed from a largely Euro-American evidence base may be insufficient to characterize the full range of phenomenologic heterogeneity across populations outside of these regions; indeed, a broader, and more culturally informed, scope of symptom phenomena should be considered (cf. Kleinman, 1977). Second, indigenous nosologic categories may not identify all symptom profiles as culturally salient, even if they are associated with distress and impairment. Third, so-called 'unsupervised learning techniques' such as LCA (Magidson & Vermunt, 2002, p. 38), in which group size and composition is not known *a priori*, may mitigate some of the limitations inherent to the application of solely *etic* or *emic* perspectives in cross-cultural evaluation by identifying novel symptom patterns. Fourth, this study provides further evidence that social environment may promote unique symptom presentations. It would be misleading, however, to interpret these results to mean that cultural context results only in superficial epiphenomenal variants on universal core pathology. Additional data are necessary to establish whether the herbal purgative class represents a clinical phenomenon with a course and outcome similar to or distinct from EDs described in high-income countries. For example, our preliminary qualitative data analysis suggests that characteristics of Fijian girls' herbal purgative use, insofar as it is sometimes abetted by parents or temporally unrelated to overeating, may be distinctive from purging typical of BN.

Also of note, the BN-like class in our study endorsed EDE-Q scores substantially lower than those reported for BN-like classes identified in an American LPA (Eddy *et al.* 2009) and European LCA (Pinheiro *et al.* 2008), but comparable to the population median for American female undergraduates (Luce *et al.* 2008). Notably, more than half of participants in both classes endorsed the use of traditional herbal therapy to prevent an indigenous illness, *macake*, which is characterized by poor appetite. The juxtaposition of a weight-loss prevention strategy with purgative use suggests that weight and shape concerns may not be central to all ED presentations in Fiji. EDs resembling AN, but presenting in the absence of weight concerns, have also been described in non-Western populations (Ong *et al.* 1982; Lee *et al.* 2001; Bennett *et al.* 2004). Taken together, this cultural variation in

the presentation of eating pathology supports the possibility that cultural context may attenuate or exacerbate the cognitive symptoms associated with disordered eating.

Our findings should be interpreted in light of design strengths and limitations. With regard to strengths, first, we developed and adapted assessments to be culturally appropriate and in the local vernacular language, drawing from foundational ethnographic data and expert local knowledge. Second, we considered and excluded potential confounding by impoverished food environment (le Grange *et al.* 2004). Third, the mean CIA score for the herbal purgative class approached the clinical cut-off of 16 that separated ED cases from non-cases in the original validation sample (Bohn *et al.* 2008), which supports our interpretation of herbal purgative as an ED symptom.

One limitation is the use of primarily self-report data to identify and validate the latent classes. Moreover, our characterization of the heterogeneity and complexity of rationales for herbal purgative use in this sample is preliminary and incomplete. Indeed, in our evaluation of herbal purgative use through narrative data, a sizeable minority of respondents did not explicitly attribute their herbal purgative use to shape and weight. Therefore, it is likely that at least some of the herbal purgative use observed in the present study may have been motivated by alternative socially sanctioned indications (e.g. medicinal usage). However, it is also conceivable that individuals may not formulate herbal purgative use as motivated by weight concerns if they do not regard weight control as a socially legitimate pursuit. Relatedly, other investigators have commented on the validity of evaluating eating pathology with self-report *versus* interview assessment, highlighting the potentially greater candor evidenced in self-reports of socially stigmatized behaviors (Keel *et al.* 2002; Mond *et al.* 2007). A second limitation is that our selection of LPA indicators and validators, although informed by extensive ethnographic work with this population, necessarily reflects our Western conceptual models of disordered eating and related distress. A third limitation is that, because we did not observe the two respective classes longitudinally, we could not evaluate crossover between classes or the directionality of the relationship between class membership and external validators. Fourth, LPA cannot distinguish differences in kind *versus* differences in degree. Indeed, there were more similarities than differences between the BN-like and herbal purgative classes, and future taxometric work is needed to ascertain the nature of the boundary between groups.

This study augments empirical support for cultural variation in patterning of ED symptom presentation (Lee *et al.* 2001; Franko *et al.* 2007) and also has implications for clinical practice. For example, without appropriate breadth to identify clinically relevant variation, clinical and research assessment of eating pathology can result in misclassification of true cases as non-cases (Lee *et al.* 2001; Bennett *et al.* 2004) and non-cases as cases (le Grange *et al.* 2004). Indeed, the majority of participants in the herbal purgative class would have been classified as non-purging by the EDE-Q had we not included an item referencing a culture-specific means of purging. In sum, the inclusion of populations with culturally distinctive traditions and symptoms in latent structure modeling may enhance the clinical utility of statistically derived nosological schemes in both diverse social contexts and multi-cultural populations.

Note

Supplementary material accompanies this paper on the Journal's website (http://journals.cambridge.org/psm).

Declaration of Interest

None.

Notes

[1] We also ran a second LPA in which we included any participants who self-reported binge eating and/or purging (i.e. self-induced vomiting, laxative use, or herbal purgative use) in the past 28 days via EDE-Q ($n=395$), so as to reflect the psychopathology of binge eating disorder as well as BN. The Supplementary Online Appendix describes the results of this second LPA, in which we obtained a 3-class solution featuring a BN-like class, an herbal purgative class, and a binge eating class. However,

we present the 2-class solution in our paper for two compelling reasons: (1) class membership under the 3-class solution was significantly associated with nesting within school, and we could not replicate the 3-class solution when we entered school as a covariate; and (2) two of the three classes obtained (i.e. the BN-like and herbal purgative classes) were similar to those already obtained in the first LPA.

[2] As a result of our recruitment strategy, participants could be considered nested within school. Class membership was associated with school [$\chi^2(22) = 34.92$, $p = 0.04$] but the effect size was small (Cramer's $V = 0.18$). We therefore re-ran our LPA with school as a covariate. The results were similar with regard to number of classes, proportion of participants in each class, and characteristics of each class, so we chose to present the final results of our LPA without controlling for school.

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