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Cross-lagged associations between behaviour problems and obesity in head start preschoolers

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Summary

Background: Behaviour problems and obesity are related but research findings have been inconclusive regarding the direction of effects.

Objectives: This study examined the cross-lagged associations between behaviour problems, body mass index (BMI) and obesity in preschoolers, and whether sex modified these associations.

Methods: Repeated measures of teacher-reported externalizing (EXT) and internalizing behaviour problems (clinically significant *T* scores were >90th percentile), BMI z-scores (BMI-Z) and obesity status (BMI ≥95th for age and sex) were assessed in the fall (T1) and spring (T2) of the school year in Head Start preschoolers (N = 423). Associations were examined with cross-lagged modelling.

Results: Prospective paths from T1 clinically significant EXT to both T2 BMI-Z (β = .05) and obesity (β = .18) were significant. There was no evidence that T1 BMI-Z or obesity preceded T2 behaviour problems. However, sex-specific models indicated that T1 BMI-Z was prospectively associated with higher T2 EXT for boys (β = .13), but not girls. T1 EXT was predictive of subsequent BMI-Z (β = .09) and obesity (β = .33) at T2 for girls only.

Conclusion: Findings suggest that behaviour problems, particularly externalizing behaviours, are prospectively related to childhood obesity, and early prevention methods should reflect sex-specific modifications.

KEYWORDS

behaviour problems, cross-lagged analysis, obesity, preschoolers.

1 | INTRODUCTION

Childhood obesity is a significant public health concern that disproportionately affects low-income and minority children.[1] Approximately one in eight children in the United States are obese.[2] Accumulating evidence suggests that behaviour problems (eg, externalizing and internalizing behaviours) frequently co-occur with obesity in children[3-5] but the directionality of effects remains unclear, compromising the efficacy

of early prevention methods.[6] Most studies of behaviour problems and childhood obesity have focused on school-age children and adolescents (5-18 years)[5] while neglecting the preschool period of development during which rapid weight gain and obesity,[7] as well as behaviour problems, particularly externalizing behaviours,[8] often emerge. Given the especially high risk of obesity among low-income children, it is critical to identify the directional pattern of association with behaviour problems and sex-specific variations in this link. The current study examined associations between behaviour problems and body mass index (BMI) and obesity and whether child sex modified these associations in low-income preschoolers. Clarifying directionality in these associations may be used to inform targeted prevention and intervention efforts in reducing risk for behaviour problems in the context of childhood obesity.

1.1 | Longitudinal associations from behaviour problems to obesity

The association between children's problem behaviours and obesity may be explained by common underlying mechanisms including the child (eg, impulsivity[9]) and family characteristics (eg, higher risk demographic or parenting factors[10]). In our work we have found that non-optimal caregivers' feeding styles (eg, uninvolved, authoritative) were more often observed in families with greater demographic (eg, food insecurity) and psychosocial risk (eg, maternal depression) and this increased risk for overweight in preschoolers.[11] A number of longitudinal population-based studies have examined bidirectional associations between externalizing and internalizing behaviour problems and BMI and obesity in early childhood.[12-14] These studies have yielded mixed results. Two prospective studies found that early-occurring externalizing behaviours predicted subsequent increases in BMI z-scores and overweight/obesity status in early childhood[13] and early adolescence.[8] Greater externalizing behaviours at 24 months of age were associated with higher BMI, and this difference in BMI persisted into middle childhood.[8]

Moreover, in a sample of European children with low demographic risk (eg, high family income and maternal education), Camfferman et al.[13] tested bidirectional effects between behaviour problems and overweight status and found that internalizing behaviours at ages 1.5 and 3 years were associated with subsequent overweight status at 3 and 6 years, respectively. These bidirectional associations, however, have not been tested in low-income racial and ethnic minority preschoolers with disproportionately greater risk for both obesity and behaviour problems. Two additional prospective studies observed no longitudinal associations between externalizing and internalizing behaviours and BMI z-scores across toddlerhood[14] and from age 2 to 12 years.[12] Mackenbach et al.[15] indicated a negative relation between internalizing behaviours at age 3 and later BMI at age 4. This contradictory inverse finding was, however, mostly explained by children's emotion-related eating behaviours such that high emotional undereating may contribute to lower BMI in children with internalizing behaviours. Obesogenic eating behaviours, such as food responsiveness and emotional overeating were also suggested mechanisms through which internalizing behaviours link to BMI z-scores in children between ages 3.5 and 4 years.[16] Thus, prospective associations examined in the current study address limited understanding of bidirectionality of links in a sensitive developmental stage (eg, preschoolers) from low-income racial and ethnic minority families experiencing socioeconomic adversity.

1.2 | Longitudinal associations from obesity to behaviour problems

Some studies suggest that overweight and obesity may contribute to subsequent behaviour problems, although the magnitude of reported effects is modest. Most of this research has been conducted with school-age children, adolescents and young adults. Other studies have examined behaviour problems and BMI in early childhood but not found predictive relationships until the school-age years. For example, BMI at age 7 years predicted internalizing symptoms at age 11.[17] Bradley et al.[12] also found that higher BMI was associated with subsequent internalizing, but not externalizing behaviour problems in girls and boys, although this association was not evident in early childhood from 24 to 54 months and only emerged by first grade. Research on putative pathways linking early obesity to behaviours problems are limited and require longitudinal studies to be examined. Current understandings of mechanisms point to early internalization of social stigma and consequent difficulties in peer relations. Children with obesity are more likely victims of peer rejection, social marginalization, and bullying as they transition into school-age classroom environments, and coping with these difficulties can be manifested as externalizing and internalizing behaviour problems in middle childhood.[18,19] However, internalization of social rejection may be absent in preschoolers, buffering them from its effects on behaviour.[20,21] Overall, there is not robust evidence that greater BMI predicts behaviour problems, although relatively little research has examined BMI and behaviour problems in early childhood, particularly in low-income populations that are at disproportionately higher risk for obesity and behaviour problems.

1.3 | Sex-specific pathways

Associations between behaviour problems and BMI and obesity may differ by child sex. Girls and boys are socialized differently, and, adults may often hold different sex-specific behavioural expectations. For instance, girls' externalizing behaviours may be viewed as more problematic for parents,[22] potentially relating to parents' use of food to manage behaviour.[10] Research to date has revealed sex differences in associations between behaviour problems and BMI, although results are often inconsistent. For instance, Datar and Sturm found that behaviour problems and obesity were linked in school-age girls, but not in school-age boys.[4] However, prospective studies that examined temporal relations between obesity and behaviour problems in boys

and girls (<4 years) have shown contradictory results. For example, Chilean boys aged 1 to 5 years with overweight, compared to boys with normal weight, showed concurrently less internalizing behaviour; this association was not present in girls.[23] Conversely, girls with overweight/obesity had fewer depressive symptoms than boys with overweight/obesity at ages 2 to 3 years, with a developmental increase in both aggressive and depressive symptoms between ages 5 and 8, surpassing boys with overweight.[24] These findings may suggest, for example, that girls become attuned to social stigma about weight during the preschool years that may in turn increase risk for externalizing and internalizing behaviours.[25,26]

Additional research highlights overweight boys' greater risk for later problem behaviours. Compared to normal weight boys, 3-year-old boys with obesity display greater conduct problems concurrently and greater problems in peer relationships longitudinally (age 5). In contrast, 3-year-old girls with obesity display more prosocial behaviours than their normal weight counterparts.[27] These findings suggest that boys and girls with obesity may approach peer relationships differently. Given that girls are often socialized to be more attuned to the social nuances of social interactions and utilize peer relationships as emotional support systems, it could be that overweight/obese girls are less likely to externalize behaviours than boys in order to conform socially.

Mixed results in the current literature may reflect inconsistencies in the analytic design, age of participants, and behavioural assessments across prior studies. Sex differences in the links between behaviour problems and obesity suggest varying risk for boys vs girls that must be further tested. Proposed sex-specific pathways underlying bidirectional links between obesity and behaviour problems are not well known but may include sex differences in shared contributing factors to obesity and behaviour problems. For instance, girls tend to have both biological and behavioural advantage in emotional and behavioural regulation[28,29] that may reduce engagement in obesity-related behaviours (eg, emotional overeating). Boys' greater risk for externalizing and girls' greater risk for internalizing may make it easier for teachers to notice and be required to manage overweight boys' difficult behaviours. Moreover, children's emotional and behavioural adjustment varies via sex-differences in peer relationships (eg, girls' greater tendency for support seeking, boys' greater engagement in physical activity and play[30]). These findings point to risk-protective or risk-augmenting roles of peer-relationships for boys vs girls that may further increase the risk for overweight/obesity. Therefore, we aimed to examine sex differences in bidirectional links between obesity and problem behaviours.

1.4 | The present study

Elucidating the temporality of the association between preschoolers' behaviour problems and measures of BMI and obesity in community-based samples may lead to the development of more comprehensive and better targeted early childhood interventions. To address inconsistencies in the literature, the current study tested the association between preschoolers' behaviour problems and BMI and obesity. It is also imperative to identify associations using clinically significant behaviour problems.[31] By focusing on an under-studied developmental stage (early childhood) in this literature, we drew on a longitudinal (ie, two time points), community-based study of Head Start preschoolers (3-4 years). In addition, we considered sex as a variable that may contribute to differences in associations between behaviour problems and BMI and obesity. We hypothesized that more behaviour problems would be associated with subsequent increased BMI z-score and obesity in preschoolers and that higher BMI z-score and obesity would be associated with later increases in behaviour problems. We also hypothesized that the directionality of effects will differ in boys vs girls.

2 | METHODS

2.1 | Study sample

Data for this study were collected as part of a cluster-randomized community-based obesity intervention trial among 697 preschoolers participating in Head Start programs located in urban and rural Michigan from 2011 to 2015.[32,33] In accordance with Head Start program eligibility guidelines, participants' family incomes were at or below the federal poverty level. Study randomization occurred in the fall of the school year into one of three study arms embedded in Head Start (HS). One arm consisted of exposure to the Preschool Obesity Prevention Series (POPS), which focused primarily on nutrition education for children and parents and healthy mealtime planning for parents (HS + POPS). The second arm included POPS exposure in addition to the Incredible Years Series (IYS), a program that emphasizes positive behavioural management techniques (HS + POPS + IYS).[34] The interventions consisted of classroom lessons for children during HS, as well as parent groups. The control arm consisted of the usual HS exposure (HS/Control). Exclusion criteria were significant medical problems or developmental disabilities, foster case, or non-fluency in English. Although there were no significant intervention effects on child's weight status in the larger study,[32] we took a conservative approach to account for any potential intervention effects and excluded participants allocated to the second arm (HS + POPS + IYS) from the current study. Thus, data from 442 participants, 224 (51%) allocated to HS + POPS and 218 (49%) allocated to HS/Control, were retained for further analyses.

2.2 | Procedure

Data collection occurred in the fall between September and October (pre-assessment; T1) and in the spring between April and May (post-assessment; T2). Demographic factors, anthropometry, and behaviour problems were measured at both time points. Data were collected from teachers, parents and their children either in the home or classroom setting. Parents received up to $150 for data collection activities. Prior to data collection, the study received institutional review boards of the University of Michigan and Michigan State University approval and written informed consent was obtained.

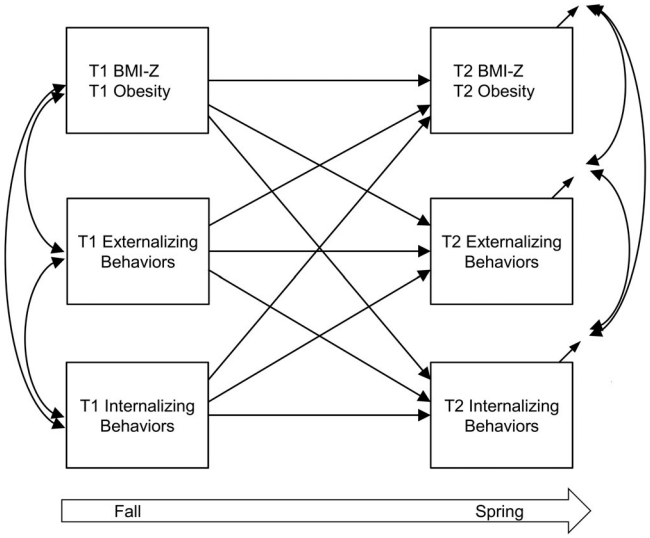

FIGURE 1 Proposed path model examining cross-lagged associations between behaviour problems (assessed by the Social Competence and Behavior Evaluation Scale completed by a teacher), BMI-Z and obesity at fall and spring of school year in preschoolers. BMI-Z indicates body mass index z-score

2.3 | Measures

The Social Competence and Behavior Evaluation Scale,[35] composed of 60 items, was used to measure children's externalizing (EXT) and internalizing (INT) behaviour problems via teacher report. Normalized *T* scores (*M* = 50, SD = 10) for age and sex were generated, with higher scores corresponding to more problematic behaviours. Teacher-reported behaviour problem scores ranged from 30 to 70. Internal consistency was high for teacher-reported EXT (α_{T1} = .92; α_{T2} = .93) and INT (α_{T1} = .83; α_{T2} = .84) scales. *T* scores were categorized as "clinically significant"[31] behaviour problems when they were >90th percentile for the entire sample.

Research staff measured participants without shoes or heavy clothing. Measures were taken twice and averaged. BMI was calculated and child BMI z-score (BMI-Z) derived.[36] Obesity was defined as a BMI ≥95th percentile for age and sex.

Parents reported child sex, age, race and ethnicity, and childbirth weight (kg) at study intake. Parent BMI was calculated based on weight and height measured by research staff.

TABLE 1 Demographic and study assessment data (*N* = 423)

	Mean ± SD or *n* (%)
Demographic data	
Child age, y	4.10 ± 0.50
Child sex	
Boys	208 (49.2)
Girls	215 (50.8)
Child race/ethnicity	
White, non-Hispanic	187 (44.2)
Black, non-Hispanic	128 (30.3)
Hispanic or other race	106 (25.1)
Birth weight, kg	3.24 ± 0.57
Parent age, y	29.58 ± 6.66
Parent education	
≤High school diploma or GED	208 (49.2)
Parent BMI, kg/m^2	31.39 ± 8.79
Parent weight status	
Obese (BMI ≥30)	195 (46.1)
Single parent household	159 (37.6)
Time 1 assessment data	
Externalizing behaviours	
T-score	48.56 ± 10.11
Clinically significant	53 (12.5)
Internalizing behaviours	
T-score	48.08 ± 8.87
Clinically significant	39 (9.2)
BMI-Z	0.698 ± 1.046
Obesity	64 (15.1)
Time 2 assessment data	
Externalizing behaviours	
T-score	50.38 ± 9.52
Clinically significant	54 (12.8)
Internalizing behaviours	
T-score	47.39 ± 8.72
Clinically significant	32 (7.6)
BMI-Z	0.704 ± 0.988
Obesity	54 (12.8)

Note:Two participants were missing child race/ethnicity data (<1%).
Abbreviation: BMI-Z, body mass index z-score; GED, General Educational Development.

2.4 | Statistical analyses

Data were inspected for potential outliers using an interquartile range approach (above 3 quartiles). One child was 72 months of age at intake and dropped from further analyses. The current study also excluded children who were categorized as underweight (BMI ≤5th percentile for age and sex) at either T1 or T2 (*n* = 18). A total of 423 children were retained for further analyses. Of the total sample, 80% had complete data or missed data on only one or two key study variables. Fewer than 5% of the cases were missing all T2 key measures. No key variables were missing for more than 25% of the sample.

To examine the bidirectional longitudinal associations between behaviour problems and BMI and obesity, cross-lagged analyses were conducted within a structural equation modelling (SEM) framework using M*plus* 8.[37] The proposed model depicting cross-lagged paths is presented in Figure 1. By drawing on longitudinal data, cross-lagged analysis models the relation between T1 BMI and obesity and T2

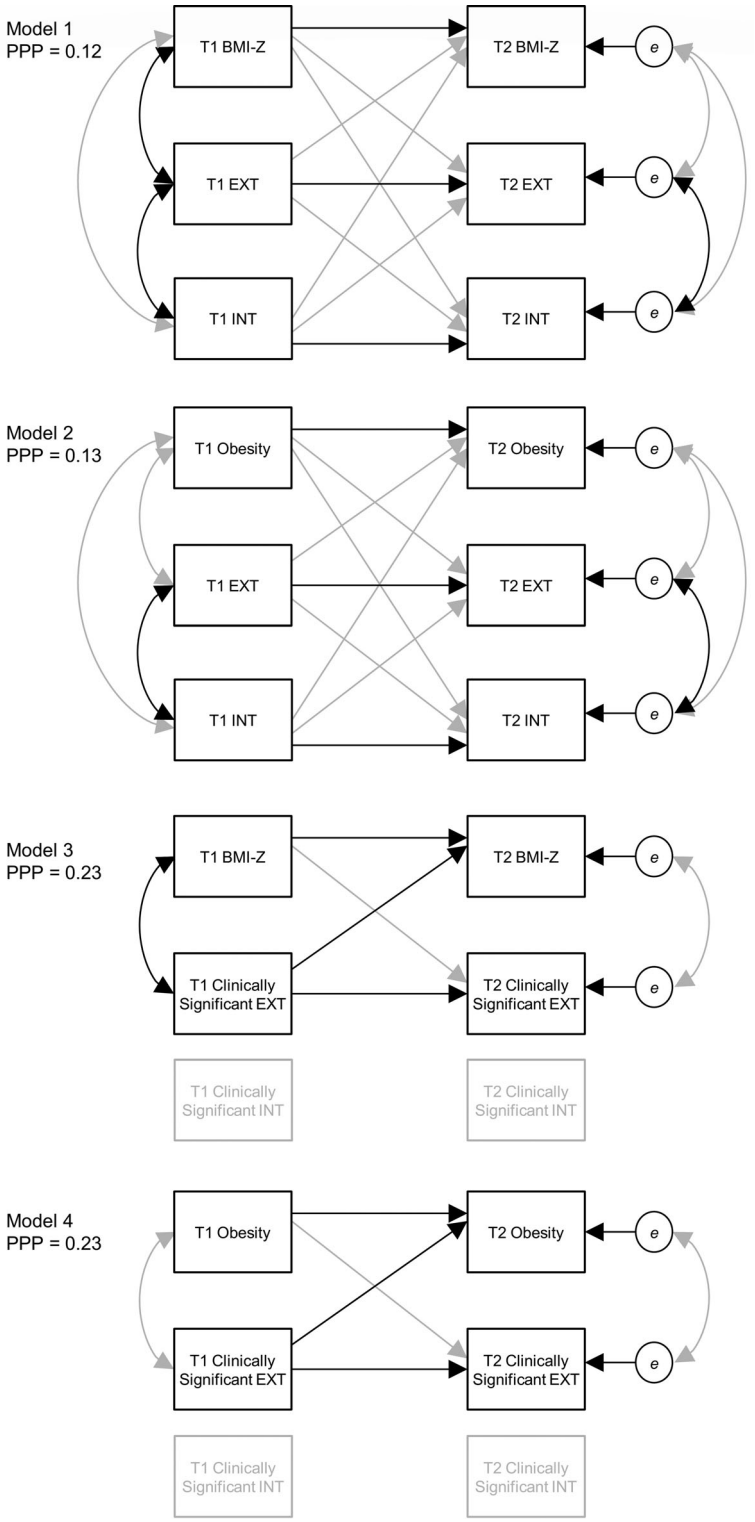

FIGURE 2 Cross-lagged associations between BMI-Z/obesity and teacher-reported behaviour problems for full sample models. Bold paths are significant at $P < .05$. The proportion of children with clinically significant internalizing behaviours was low and, thus, excluded from models 3 to 4. BMI-Z indicates body mass index z-score; EXT, externalizing behaviours; INT, internalizing behaviours; PPP, posterior predictive *P*-values

behaviour problems, while simultaneously modelling the relation between T1 behaviour problems and T2 BMI and obesity. In order to examine the unique effects of EXT and INT, these variables were modelled simultaneously, with each controlling for the effects of the other. Using multivariate SEM, four models were computed using combinations of continuous and categorical (clinically significant) EXT and INT variables with BMI-Z and obesity variables (Model 1 used continuous EXT, INT, and BMI-Z variables; Model 2 used continuous EXT and INT variables and categorical obesity variable; Model 3 used categorical EXT and INT variables and continuous BMI-Z variable; Model 4 used categorical EXT, INT, and obesity variables). The second set of analyses examined these models using multi-group mixture modelling with known classes to test sex-specific associations between boys and girls.

Employing Bayesian estimation technique, model fit was evaluated with Bayesian posterior predictive checks using χ^2 statistics and the corresponding posterior predictive *P* values (PPP). A *P* value within

TABLE 2 Standardized path coefficients for the associations between teacher-reported behaviour problems and BMI-Z/obesity by child sex

	BMI-Z PPP = .19		Obesity PPP = .25	
	Boys	Girls	Boys	Girls
Time stability paths				
T1 BMI-Z/obesity → T2 BMI-Z/Obesity	.94*	.87*	.75*	.57*
T1 EXT → T2 EXT	.63*	.63*	.63*	.63*
T1 INT → T2 INT	.49*	.43*	.49*	.43*
Cross-lagged paths				
T1 EXT → T2 BMI-Z/Obesity	−.05	.09*	−.12	.33*
T1 INT → T2 BMI-Z/Obesity	.04	−.05	−.07	.09
T1 BMI-Z/obesity → T2 EXT	.13*	−.02	.06	−.01
T1 INT → T2 EXT	.02	−.10	.02	−.11
T1 BMI-Z/obesity → T2 INT	.01	.09	−.03	.02
T1 EXT → T2 INT	.06	.04	.07	.05
Covariances				
T1 BMI-Z/obesity ↔ T1 EXT	.04	.21*	.04	.13
T1 BMI-Z/obesity ↔ T1 INT	.02	.07	.02	.00
T1 EXT ↔ T1 INT	.49*	.30*	.49*	.30*
T2 BMI-Z/obesity ↔ T2 EXT	.09	−.03	.15	−.16
T2 BMI-Z/obesity ↔ T2 INT	−.08	−.14	.09	.07
T2 EXT ↔ T2 INT	.23*	.29*	.24*	.28*

Abbreviations: BMI-Z, body mass index z-score; EXT, externalizing behaviours; INT, internalizing behaviours; PPP, posterior predictive *P*-values.
*Significant at $P < .05$.

.05 to .95 range is indicative of acceptable model fit.[38] Bayesian techniques were found to increase model power, particularly when estimating binary outcomes, and to increase the likelihood of unbiased parameter estimates.[39] Missing data were handled using full information maximum likelihood estimation. Models controlled for T1 measures of child's sex, age, race and ethnicity, and birth weight, parent BMI and intervention assignment (HS + POPS vs HS/Control).

3 | RESULTS

Characteristics of the current analytic sample are shown in Table 1. Children (51% girls) were on average 4.1 years old (SD = 0.5) and the cohort was 44% White (non-Hispanic), 30% Black (non-Hispanic) and 25% Hispanic or other. Parents were on average 30 years old at the intake interview (SD = 6.7). About half of all parents had a high school education or less (49%) and about half were obese (46%). About one-third (38%) of families were living in single-parent households.

3.1 | Cross-lagged associations in full sample

Fit statistics of the four full sample cross-lagged models indicated good model fit (PPP's ranged from .12 to .23; see Figure 2). Time stability path estimates were moderate to highly stable over time. In models 1 to 2, T1 EXT and INT were not associated with T2 BMI-Z and obesity. T1 BMI-Z and obesity were not associated with T2 EXT and INT. There was a significant cross-sectional association between EXT and BMI-Z at T1 (β = .12; 95% CI, 0.02-0.21); there were no other significant cross-sectional associations between EXT or INT and BMI-Z and obesity at T1 or T2.

Cross-lagged models were underpowered to sufficiently test categorical INT. Therefore, full sample models 3 to 4 omitted clinically significant INT and examined clinically significant EXT associations with BMI-Z and obesity only. T1 clinically significant EXT was prospectively associated with higher T2 BMI-Z (β = .05; 95% CI, 0.00-0.09) and obesity (β = .18; 95% CI, 0.04-0.31). No relations were found for either BMI-Z or obesity at T1 and subsequent clinically significant EXT at T2. Concurrently, the association between clinically significant EXT and BMI-Z was significant at T1 (β = .14; 95% CI, 0.04-0.23).

3.2 | Multi-group cross-lagged associations by child sex

Similarly, fit statistics of multi-group cross-lagged models 1 (PPP = .19) and 2 (PPP = .25) indicated good model fit. Models 3 to 4 were underpowered to sufficiently test cross-lagged associations in a multi-group structure and thus no further discussion. As shown in Table 2, time

stability estimates were moderate to highly stable over time for both boys and girls.

3.2.1 | Cross-lagged associations among boys

T1 BMI-Z was significantly associated with T2 EXT (β = .13; 95% CI, 0.01-0.25). There were no other significant cross-lagged or cross-sectional associations between INT or EXT and BMI-Z and obesity.

3.2.2 | Cross-lagged associations among girls

T1 EXT was significantly associated with T2 BMI-Z (β = .09; 95% CI, 0.01-0.16) and obesity (β = .33; 95% CI, 0.10-0.53). T1 EXT was associated with T1 BMI-Z (β = .21; 95% CI, 0.07-0.35). There were no other significant cross-lagged or cross-sectional associations between INT or EXT and BMI-Z and obesity.

It should be noted that no significant HS + POPS program effects were observed in the full sample models. However, in the multi-group models, HS + POPS impacted girls' EXT at T2 (β = −.17; 95% CI, [−0.28 to −0.05]). To test the robustness of our findings, models were re-calculated including families allocated to the HS/Control group only. Model estimates did not change appreciably when excluding the HS + POPS sample.

4 | DISCUSSION

The purpose of the current study was to examine cross-lagged associations between teacher-reported behaviour problems and BMI-Z in a sample of preschool children from low-income families participating in Head Start. The results confirm our hypothesis that clinically significant externalizing behaviours at T1 were associated with subsequent BMI and obesity at T2. Findings also confirmed our hypothesis that the temporal directionality of pathways between externalizing behaviours and BMI and obesity differed between boys and girls. While boys with higher BMI were at an increased risk of exhibiting subsequent externalizing behaviour problems, girls with higher BMI were not. However, girls with higher early externalizing behaviour problems were at greater risk for later obesity. No associations were observed between internalizing behaviours and BMI or obesity.

The associations seen in the current sample, after accounting for several relevant covariates, attest to the robust nature of externalizing behaviours as a risk factor for future obesity, particularly for girls. Elucidating the mechanisms through which externalizing behaviours are associated with obesity risk is imperative to practical implications. For instance, externalizing behaviours may confer relatively greater risk for later obesity as it may be more difficult for parents of children with externalizing to successfully regulate and respond to frequent food requests. Parents with difficulties in limit-setting may use food to manage their child's difficult behaviours[10] or allow more unhealthy foods or screen time. Girls with high externalizing behaviours may posit challenges for parents and elicit less supportive socialization behaviours from adults in part because externalizing behaviours are often less expected or accepted in girls than in boys.[22]

Another mechanism through which externalizing behaviours may be associated with obesity risk is poor self-regulation. Dysregulated emotions and behaviours, present in externalizing children, particularly girls, may interfere with children's ability to respond appropriately to their internal feelings of hunger, which may result in overeating and ultimately becoming obese.[9] As preschool boys and girls often differ in their regulatory skills,[28,29] these preliminary findings may shed light on sex-related differences in underlying pathways that must be further examined and addressed in obesity prevention programming for preschool boys vs girls.

Children with obesity are more likely to be victims of peer rejection, social marginalization and bullying as they transition into school-age classroom environments and these difficulties can be manifested in externalizing behaviour problems.[18,19] Children with obesity are often perceived more negatively by adults[40] and such biases could contribute to teachers' perceptions of behaviour problems in boys with obesity. Given this, the relation between BMI and later externalizing behaviours in boys only, but not in girls, is somewhat surprising. Prior research has shown that girls become aware of societal preference for thinness in the preschool years[25] and are attuned to the stigma of obesity by the school-age years.[26] Hence, we might have expected any negative messages about obesity to contribute to girls' behavioural problems. Additionally, evidence for links between child sex and physical activity point to boys' greater tendency for engagement in physical activity compared to girls.[41] However, lack of physical activity observed in preschool boys with obesity may limit peer interactions and increase feelings of social isolation and peer rejection which, in turn, contributes to behaviour problems.[27] Such problematic peer relations may also contribute to teachers' negative perceptions of behaviour problems in boys with obesity. Additionally, girls generally tend to exhibit more optimal emotional and behavioural regulation[42] which may have buffered them against possible social stigma (eg, well-behaved girls may be perceived as less problematic regardless of BMI). Furthermore, it may be that for girls, peer pressure for thinness and social expectations for optimal appearance increase with age and contribute to the emergence of internalizing symptoms in later stages of development such as preadolescence.[25,26]

There are several limitations to be noted in the current study. Parent–child mealtime interactions, dietary intake, and eating behaviours were not included in the current study models. As such, we cannot determine how associations with children's behaviour problem and BMI measures may have varied per such contexts. The current study was limited by its reliance on teacher report for child behaviour problems. Although we did assess children's adiposity over the school year, multi-year longitudinal cohort studies would provide a more comprehensive examination of development and allow for consideration of the role of nonlinear growth in obesity (eg, adiposity rebound). Furthermore, the intervention study context of the sample and the fact that all children were low-income and also attending Head Start limits generalizability.

In conclusion, our study contributes to the growing body of literature on associations between behaviour problems with BMI and obesity in preschool children and may inform early prevention and intervention programs addressing childhood obesity. Reducing the prevalence of childhood obesity is a public health challenge, and prevention and intervention services targeting early-occurring externalizing behaviour problems may have the potential to play a powerful role in diminishing risk for this serious health crisis. Finally, sex-specific associations suggest a greater risk for obesity in girls presenting with early behaviour problems while boys with obesity may be at greater risk for later behaviours problems.

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CONFLICT OF INTEREST

No conflict of interest was declared.

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