

1 Article

2 The association between perceived adequacy and 3 capacity for school food policy implementation on 4 food availability and policy adherence in Nova 5 Scotia, Canada

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20 **Abstract:** Supporting the implementation of school food and nutrition policies (SFNPs) is an
21 international priority to encourage healthier eating among children and youth. Schools are an
22 important intervention setting to promote childhood nutrition, and many jurisdictions have
23 adopted policies, guidelines, and programs to modify the school nutrition environment and
24 promote healthier eating. The purpose of this study was to explore the association between
25 perceived adequacy and capacity for SFNP implementation on food availability and policy
26 adherence in the province of Nova Scotia (NS), Canada, one of the first regions in Canada to launch
27 a comprehensive SFNP. A cross sectional online survey was conducted in 2014-15 to provide a
28 current-state of policy implementation and adherence. Adequacy and capacity for food policy
29 implementation was used to assess policy adherence through the availability of prohibited
30 'minimum' nutrition foods. An exploratory factor analysis was conducted on a selected of available
31 foods and 'slow' and 'quick' service food composition measures were dichotomized for food
32 availability. Schools with above perceived average adequacy and capacity for policy
33 implementation had more than three times (3.62) greater odds of adhering to a lunch policy, while
34 schools that adhered to a snack and lunch policy had 52% and 82% lower odds of serving quick
35 service foods, respectively. This study identified the need for appropriate adequacy and capacity
36 for policy implementation to ensure policy adherence and improve the school food environment.
37 These findings highlight the potential of SFNPs to have a positive impact on childhood nutrition,
38 but adequately supporting their implementation is critical to ensure their impact.

39 **Keywords:** school health; child/adolescent health; health education; health promotion; school
40 nutrition; school health; policy

41 1. Introduction

42 Supporting the implementation of strategies to encourage healthier eating is an international
43 priority to address poor diet quality among children and youth [1]. Schools are an important
44 intervention setting to promote childhood nutrition, and many jurisdictions have adopted policies,
45 guidelines, and programs to modify the school nutrition environment and promote healthier eating

46 [2,3]. Nutrition policies can help to create healthier school environments by influencing the
47 availability of food and beverages, which subsequently may impact the nutrition behaviours of
48 students[4-9]. A recent systematic review suggested that school policies have a positive effect on
49 behavioural risk factors for non-communicable diseases (NCD), particularly when they are
50 implemented as part of a comprehensive approach [10]. For example, policies aimed at reducing
51 sugar-sweetened beverage intake or increasing fruit and vegetable intake in schools had
52 corresponding impacts on consumption patterns, although findings were mixed for other NCD risk
53 factors [10]. However, the authors noted that greater consideration of environmental or structural
54 factors that help or hinder individual behaviours might offer a more equitable approach to policy
55 implementation [10]. Thus, for policy implementation to effect the degree of change necessary for
56 sustained impact, there is a need to identify specific aspects of the school environment that will best
57 support sustainable positive changes to childhood nutrition in school settings [10-12].

58

59 The east coast province of Nova Scotia (NS) Canada has a rich history of policy action to support
60 children's health in schools. In 2006, the province was one of the first in Canada to launch a school
61 nutrition policy providing standards for foods and beverages served and sold in schools [13]. These
62 mandated standards included directives for school eating practices such as pricing, programming
63 and advertising, and guidelines that encourage schools to foster community partnerships and
64 support local food products [13]. Since the policy was introduced, funding has been distributed
65 each year to support implementation in schools but there are gaps in implementation of directives
66 that limit its potential for impact [14]. One such gap is in the ability for each school to implement
67 policy directives based on adequacy of facilities or equipment and capacity of staff to support
68 policy implementation. The purpose of this study was to explore the association of combined
69 factors of perceived adequacy and capacity for policy implementation with food availability and
70 policy adherence in schools across NS. It was hypothesized that schools with greater perceived
71 adequacy and capacity for policy implementation would be more able to adhere to the school
72 nutrition policy and to serve healthier foods.

73 **2. Materials and Methods**

74 A cross-sectional study was conducted in 2014-15 to provide an assessment of policy
75 implementation and adherence across NS, as they relate to the directives of the 2006 policy. An
76 online survey was developed and administered to assess implementation of the nutrition policy
77 across all public schools in NS (elementary, junior and senior high). The online survey was hosted
78 on a secure web-based platform and took about 15 minutes to complete. With permission and
79 support from each school board key contact, school principals were contacted by email to request
80 their participation in the online survey. The process (by research team or school board) and timing
81 for contacting school principals was determined through the advice of our key school board
82 contacts. Principals were instructed that they could also identify an appropriate designate with
83 experience in school food service to complete the survey on behalf of the school. Reminders to
84 complete survey were sent via email and through social media.

85 The measures in the survey were based on the psychometric properties of scales from similar
86 research conducted in Canada [15] and comprised questions related to the school food
87 environment. These included organizational factors, school climate, policy institutionalization and
88 perceived adequacy and capacity for policy implementation. The survey for this study added
89 questions pertaining to the directives and guidelines of the NS school nutrition policy (available
90 from the authors by request). Content review of the measures was completed by government
91 stakeholders to determine the relevance of constructs and measures for the NS context.

92 The perceived adequacy and capacity for policy implementation represented a composite measure
93 based on two dimensions that were self-reported by survey participants. These perceived adequacy
94 and capacity constructs were derived from questions related to staffing, facilities and equipment
95 available for food preparation when compared to other schools. Responses to these questions
96 were then characterized as 'below average', 'average' or 'above average' in relation to perceived
97 adequacy and capacity. Adherence to a breakfast, snack and lunch policy was self-reported through
98 the availability of certain foods that were classified into food service types, that reflected foods that
99 are likely to be 'quick' and 'slow' to prepare. Policy adherence was framed through asking '*To the
100 best of your knowledge, to what extent are minimum nutrition food and beverages sold or served in...*'.
101 Policy adherence for each type of school policy was then dichotomized to reflect that 'no minimum
102 nutrition foods served' represented 'policy adherence'.

103 Food service was then assessed within each school by asking '*How often are the following foods and
104 beverages served or sold from the school cafeteria, vending machines(s), snack bar or school store during
105 school hours?*'. Food availability for each food was dichotomized as any frequency ('daily', 3-4 times
106 per week, 1-2 times per week, 1-3 times per month or less than once per month') or 'never'. In order
107 to select relevant foods served within schools we conducted exploratory factor analysis on a
108 selection of policy relevant foods. We extracted a 2-factor solution using principal component
109 analysis with promax rotation. The first component included nachos and poutine, garlic fingers,
110 hamburgers and French fries which we labeled as 'quick service foods'; the second component
111 included prepared fresh fruit, cooked or raw vegetables, sandwiches and subs, baked chicken or
112 baked pasta dish which we labeled as 'slow service foods'. The two 2-factor solution explained 65%
113 of the variance and each scale had adequate internal consistency (Cronbach alpha) with alpha = .89
114 and .78 respectively. Slow and quick service food composition measures were dichotomized as
115 foods served at any frequency (i.e. food available) or never serving one of the included foods.

116 In terms of covariates, self-reported survey questions were used to assess school grades, number of
117 students and number of staff within each school. To provide an indicator of community
118 socioeconomic status, the median community income was assessed using 2016 census data and
119 matched with the school community name. School rurality was assessed using the second
120 character of school postal codes (0 representing rural, 1 representing urban). Descriptive statistics
121 were used to summarize school characteristics, the combined measure of perceived adequacy and
122 capacity for policy implementation, policy adherence, and food availability (both individual foods
123 and composite measures) across school grades. Binary logistic regressions were first used to
124 evaluate breakfast, snack and lunch policy adherence by level of perceived staffing and facility
125 adequacy and capacity (unadjusted). Models were then adjusted for school size, community
126 median income and rurality. Binary logistic regression were also used to evaluate slow and quick
127 service food availability composite measures by adherence to breakfast, snack and lunch policy
128 (unadjusted). Models were then adjusted for school size, community median income and rurality.
129 Complete case analysis was used for missing outcome data, while missing exposure or covariate
130 values were examined, with no significant differences in percentages across exposure levels or
131 outcomes. Missing values were categorized for each variable and included in appropriate models to
132 avoid additional case deletion (i.e. missing indicator approach). Analyses were conducted using
133 Stata 12.

134

135 3. Results

136 Our sample included 237 schools across Nova Scotia, Canada (59% of all schools). Several schools
137 comprised more than one grade level, and these included 170 elementary grades
138 (primary/kindergarten to grade 6, ages 5-11 years), 85 junior high grades (grades 7 to 9, ages 12-14
139 years) and 56 high school grades (grades 10 to 12, ages 15-18 years) with an average of 332 students,

140 and 33 staff per school (Table 1). Median community income across school locations was \$30,627
 141 CDN and 63% of schools were located in urban areas. Adequacy and capacity for policy adherence
 142 were mostly reported as average; in some instances, greater percentages were below rather than
 143 above average. Staffing resources were reported as above average by 8.4%, below average by 24%
 144 and average by 59% of schools. Facility resources were reported as above average by 28%, below
 145 average by 22% and average by 43% of schools. Twenty five percent of schools reported breakfast
 146 policy adherence, while snack policy adherence was reported by 22% and lunch policy adherence
 147 was reported by 19% of schools. Quick service foods were served in 64% of schools, while slow
 148 service foods were served in 89% of schools.

149 **Table 1: School characteristics for analytical sample by grades within each school, N= 237¹**

Classification	Characteristic	School grades			Total ¹
		Elementary school	Jr. High school	High school	
Socio-demographic					
<i>School</i>	Number of school grades (N)	170	85	56	311
	Number of students (mean, SE)	268 (14)	340 (19)	537 (19)	332 (16)
	Number of staff (mean, SE)	29.8 (1.5)	36.0 (1.7)	47.9 (3.3)	33.4 (1.2)
<i>Socio-economic</i>	Community income (median, IQR)	\$30,627 (7130)	\$29,973 (7223)	\$28,968 (5687)	\$30,627 (7130)
<i>School rurality</i>	Urban % (N)	58% (99)	55% (47)	50% (28%)	63% (150)
Policy implementation					
<i>Staffing/Financial capacity</i>	Average % (N)	60% (102)	40% (57)	57% (32)	59% (141)
	Below average % (N)	24% (41)	18% (15)	27% (15)	24% (57)
	Above average % (N)	7.0% (12)	7.0% (6)	14% (8)	8.4% (20)
<i>Adequacy of Facilities</i>	Average % (N)	44% (75)	41% (35)	41% (23)	43% (103)
	Below average % (N)	24% (41)	22% (19)	14% (8)	22% (53)
	Above average % (N)	25% (42)	31% (26)	43% (24)	28% (67)
Policy Adherence²					
<i>Breakfast</i>	No minimum nutrition % (N)	27% (47)	22% (19)	16% (9)	26% (61)
	At least some % (N)	63% (107)	65% (55)	79% (44)	63% (149)
<i>Snack</i>	No minimum nutrition % (N)	24% (42)	14% (12)	11% (6)	22% (53)
	At least some % (N)	62% (106)	72% (61)	79% (44)	63% (150)
<i>Lunch</i>	No minimum nutrition % (N)	22% (37)	14% (12)	13% (7)	19% (45)
	At least some % (N)	69% (117)	71% (60)	82% (46)	70% (165)
Food availability³					
<i>Quick service foods</i>	Nacho and poutine % (N)	22% (37)	42% (36)	46% (26)	26% (63)
	Never % (N)	72% (122)	47% (40)	48% (27)	65% (154)
	Garlic fingers % (N)	33% (57)	42% (36)	54% (30)	34% (81)
	Never % (N)	60% (102)	46% (39)	41% (23)	57% (136)
	Hamburger % (N)	48% (81)	65% (55)	73% (41)	52% (123)
	Never % (N)	46% (78)	25% (21)	21% (12)	40% (94)
	French fries % (N)	48% (82)	62% (53)	77% (43)	53% (126)
	Never % (N)	44% (75)	25% (21)	14% (8)	37% (88)
<i>Quick service foods composite</i>	Quick foods served % (N)	59% (101)	73% (62)	88% (49)	64% (151)
	Never % (N)	35% (59)	16% (14)	7% (4)	28% (67)
<i>Slow service foods</i>	Fresh fruit % (N)	79% (135)	79% (67)	91% (51)	80% (188)
	Never % (N)	15% (25)	12% (10)	5% (3)	13% (31)
	Cooked/raw vegetables % (N)	74% (126)	78% (66)	91% (51)	75% (176)
	Never % (N)	20% (35)	14% (12)	5% (3)	19% (44)
	Sandwiches and subs % (N)	73% (125)	74% (63)	89% (50)	73% (175)
	Never % (N)	20% (35)	15% (13)	4% (2)	18% (43)
	Baked chicken % (N)	62% (106)	66% (56)	77% (44)	62% (148)
	Never % (N)	30% (52)	22% (19)	16% (9)	28% (67)
	Baked pasta dish % (N)	166% (112)	72% (61)	91% (51)	68% (163)
	Never % (N)	26% (45)	16% (14)	5% (3)	22% (53)
<i>Slow service foods composite</i>	Slow foods served % (N)	92% (156)	87% (74)	96% (54)	89% (211)
	Never % (N)	4% (7)	5% (4)	0% (0)	5% (11)

¹ Several schools are combined, therefore the number of school grades will be greater than the total number of schools

² Minimum nutrition foods served "never"

³ Food availability is % of schools that serve foods more than "never"; composite measures are for serving any of the quick or slow foods.

150

151 The results of the regression analysis showed no association between staffing resources and policy
 152 adherence. However, schools reporting above average facility resources were associated with
 153 greater odds of adhering to a school lunch policy after adjustment (OR=3.62, CI=1.56,8.40), but not a
 154 snack or breakfast policy (Table 2).

155 **Table 2. Odds ratios and 95% confidence intervals for breakfast, snack and lunch policy**
 156 **adherence by combined adequacy and capacity**

Odds of policy adherence ¹	Combined Adequacy and Capacity for Policy Implementation		
	Average	Above average	Below average
Staffing Capacity			
<i>Breakfast policy (n=199)</i>			
Unadjusted	REF	0.88 [0.43, 1.82]	0.97 [0.32, 2.92]
Adjusted ²	REF	0.87 [0.42, 1.82]	0.87 [0.28, 2.66]
<i>Snack policy (n=192)</i>			
Unadjusted	REF	1.00 [0.47, 2.11]	1.80 [0.60, 5.36]
Adjusted ²	REF	0.83 [0.38, 1.82]	1.85 [0.57, 5.99]
<i>Lunch policy (n=196)</i>			
Unadjusted	REF	1.43 [0.66, 3.09]	1.32 [0.40, 4.41]
Adjusted ²	REF	1.36 [0.62, 2.96]	1.44 [0.42, 4.95]
Facilities Adequacy			
<i>Breakfast policy (n=203)</i>			
Unadjusted	REF	1.12 [0.51, 2.47]	0.96 [0.47, 1.95]
Adjusted ²	REF	1.15 [0.52, 2.56]	0.99 [0.46, 2.13]
<i>Snack policy (n=197)</i>			
Unadjusted	REF	1.68 [0.76, 3.70]	0.82 [0.38, 1.77]
Adjusted ²	REF	1.49 [0.66, 3.35]	1.26 [0.54, 2.91]
<i>Lunch policy (n=201)</i>			
Unadjusted	REF	3.78 *** [1.64, 8.71]	1.36 [0.58, 3.18]
Adjusted ²	REF	3.62 *** [1.56, 8.40]	1.51 [0.62, 3.69]
¹ No minimum nutrition foods served			
² Adjusted for school size, community median income and rurality			
*p<0.05, **p<0.01, ***p<0.001			

157

158 Additional results showed no association between adherence to a breakfast, snack or lunch policy
 159 and slow service foods. However, schools that reported adherence to a snack and lunch policy
 160 was associated with lower odds of having quick service foods available within the school after
 161 adjustment OR=0.48, CI=0.23,1.01 and OR=0.18, CI=0.08,0.41, respectively (Table 3).

162 **Table 3. Odds ratios and 95% confidence intervals for slow and quick serve food availability by**
 163 **breakfast, snack and lunch policy adherence**

Odds of food availability ¹	Do not adhere to policy ²	Adhere to breakfast policy	Adhere to snack policy	Adhere to lunch policy
<i>Slow service foods (n=208)</i>				
Unadjusted	REF	2.93 [0.35, 24.33]	0.58 [0.13, 2.51]	0.82 [0.16, 4.22]
Adjusted ³	REF	3.04 [0.35, 26.28]	0.77 [0.16, 3.69]	1.13 [0.21, 6.15]
<i>Quick service foods (n=205)</i>				
Unadjusted	REF	0.74 [0.38, 1.41]	0.37*** [0.19, 0.72]	0.20*** [0.10, 0.40]
Adjusted ³	REF	0.76 [0.36, 1.59]	0.48* [0.23, 1.01]	0.18*** [0.08, 0.41]
¹ Slow or quick foods provided daily, weekly or monthly within the school				
² No minimum nutrition foods served = policy adherence				
³ Adjusted for school size, neighbourhood median income and rurality				
*p<0.05, **p<0.01, ***p<0.001				

164

165 **4. Discussion**

166 This study sought to explore the association between adequacy and capacity for policy
 167 implementation on food availability and policy adherence in NS. It was hypothesized that schools
 168 with greater adequacy and capacity for policy implementation and adherence to the school nutrition
 169 policy would be more likely to serve healthier foods. Our results suggest that schools with above
 170 average facilities had more than three times (3.62) greater odds of adhering to a lunch policy, while
 171 schools that adhered to a snack and lunch policy had 52% and 82% lower odds of serving quick
 172 service foods, respectively.

173

174 Following an exploratory factor analysis, this study considered two types of foods, 'quick'
 175 versus 'slow' service foods, as a proxy for the healthfulness of the types of foods available in schools.
 176 To our knowledge, this is the first data-driven use of this type of conceptualization for foods available
 177 in schools. Research has previously considered the impact of less healthy foods on the diets of
 178 children using terms such as 'convenience or commercially-prepared foods' [16] or 'fast-food' [17].
 179 One study examined the effect of fast-food and full-service restaurant consumption among children
 180 and youth and found that both were associated with higher energy intake and better diet quality [18].
 181 Although 'slow' service foods may be considered intuitively healthier, further research is needed to
 182 determine how these, and how 'quick' service foods, are associated with children's diet quality.

183

184 This study found that schools with well-equipped facilities were more likely to adhere to the
 185 school nutrition policy for lunch programs, suggesting that improvements to the physical
 186 infrastructure of schools may be necessary to ensure access to proper equipment to prepare healthier
 187 foods for students. Alternatively, these schools might simply have a more structured approach to
 188 policy implementation as a function of being well-equipped. These differences may be particularly
 189 important for schools within communities of lower socioeconomic status as research has found that
 190 these schools struggle with the resources required for policy implementation [19-25], whereas schools
 191 in communities with higher socioeconomic status had more resources and opportunities and were
 192 better able to implement nutrition policies [26-29].

193

194 A strength of this study is the use of a data-driven approach that builds on the evidence from
 195 the aforementioned qualitative studies. The sample of schools, at 59% of all schools in the province,
 196 is also large. A key limitation is the use of self-reported data in assessing the school food environment.
 197 Self-report is known to be subject to bias, and in this context, may lead to optimism bias, whereby the

198 foods provided in schools are considered to be healthier than when assessed using objective
 199 measures. Our classification of foods as 'slow' or 'quick' service, while data driven, may also not fully
 200 align with other examples from dietary pattern analyses, thereby limiting comparison with other
 201 studies [30].
 202

203 5. Conclusions

204 School nutrition policies have the potential to have a positive effect on childhood nutrition, but
 205 supporting their implementation is critical to ensure their impact. A recent scoping review mapped
 206 the broad and local-system factors that influence policy implementation, identifying the importance
 207 of structural features of school communities, including school infrastructure [31]. This study builds
 208 on the existing evidence by identifying the importance of school adequacy and capacity for policy
 209 implementation to ensure policy adherence and improve the school food environment.
 210 Understanding the potential impact of these school-level factors on policy implementation helps to
 211 identify opportunities for intervention to support sustainable positive changes to childhood
 212 nutrition.

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 214 formal analysis, T.P. and L.M.; writing—original draft preparation, J-L.D.M and T.P.; writing—review and
 215 editing, J-L.D.M, T.P., L.M. and S.F.L.K.; supervision, J-L.D.M. and S.F.L.K.; project administration, J-L.D.M. and
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