

**The Relationship between Breakfast, Academic Performance and
Vigilance in School Aged Children**

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Declaration

I declare that this dissertation is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary institution.

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Abstract

This research was designed to investigate the relationship between breakfast habits and academic performance and vigilance in upper primary children. The content of breakfast consumed, the frequency of skipping breakfast, gender differences, social impacts and reasons for skipping breakfast in upper primary school children are also examined. There is little Australian research on children's breakfast habits or its relationship with academic performance and vigilance. Hence there is a need for research on this issue in the Australian context.

The study involved 72 children of 5th, 6th and 7th grades from two schools in Western Australia. Data were obtained in three ways (a) the children completed a questionnaire which explored their breakfast habits, (b) the class teachers recorded the classroom performance/grades based on their classroom evaluations, and behaviour of the children based on the observations, and (c) the children were then given three vigilance tasks approximately one and a half hours into the school day. The children were divided into breakfast and no-breakfast groups based on the self-report of breakfast consumption on that day.

The study found that more than half of the children at least sometimes skip their breakfast, with no differences attributed to gender. A number of children reported eating breakfast on the way to school but the proportion of those having a nutritious breakfast on the way to school was almost negligible. Even those having breakfast regularly (55%) might not be consuming a nutritious breakfast. Children reported feeling sleepy, inactive and forgetful as a consequence of skipping breakfast on the day. Reasons offered for skipping mainly had to do with personal choice and convenience, rather than with dieting

and concern about body shape. There was no relationship found between breakfast skipping and academic performance and vigilance. Evidence that breakfast skipping affects concentration span of children was found for year 6 and 7 students in the study.

Potential strategies based on the findings of this study are discussed. Providing a nutritious breakfast for children or supplementing their daily diets with fruit are interventions which have the potential to make a significant impact on children's health and well-being. In order to have a nutritious breakfast, children should be encouraged to have breakfast at home before leaving for school as they usually tend to eat a less nutritious breakfast on the way to school or at school. Organizing a breakfast day at school will also promote the importance of having breakfast. Further emphasis on nutrition and healthy eating in schools could make a difference.

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Chapter One

INTRODUCTION

Introduction

This research aims to investigate the relationship between breakfast and academic performance and vigilance. The content of breakfast consumed and the frequency of skipping breakfast as well as reasons for skipping breakfast in upper primary school children are also examined.

The notion that breakfast is the most important meal of the day is popular among parents and educators. Nonetheless, the validity of the notion behind this statement remains in question. Researchers have been trying to determine the value of breakfast consumption for children with respect to cognitive performance and academic attentiveness for over half a century. Studies have been conducted over the short-term, examining the effect of skipping one meal, and over the longer-term, examining the effect of repeated omission of breakfast on learning. Both experimental studies conducted under controlled laboratory conditions and field studies examining real world situations have been undertaken. Effects in malnourished and well-nourished children have been researched.

While the majority of the research available validates the fact that eating breakfast has positive results on health, behaviour, vigilance, and academic performance, there are some researchers who argue differently. Some studies illustrate there are no deleterious effects on academic performance, vigilance, and cognitive ability from skipping breakfast (Lopez, 1993). Generally, the findings of studies have been inconsistent, with either few or no detrimental effects being demonstrated.

A brief review of the literature reveals that Australian research investigating the relationship between breakfast, academic performance and vigilance in school aged children is not substantial during the past decade. Moreover, there is a need to investigate whether or not well-off and well-nourished children (non-at-risk), who skip breakfast due to reasons other than poverty like being late, getting up late, laziness, or losing body weight, are adversely affected in terms of academic performance and vigilance. Vigilance can be defined as the process of maintaining attention or the ability to sustain attention (Stroh, 1971). The ability to sustain attention is an important factor which may affect children's performance in many tasks (Rueckert & Grafman, 1996; Wilkins, Shallice, & McCarthy, 1987). Hence the main focus of the research is to investigate the performance of children with the ability to sustain attention.

Skipping breakfast creates a state of hunger. There is no universally accepted definition of hunger because of its multi-factorial complexity, which includes not only metabolic, and neuro physiological factors but also an emotional component. Moreover, the manifestations of hunger are likely to interact with the nutritional history and status of the individual as well as with the frequency with which it has been experienced (Pollitt, Gersovitz, & Gargiulo, 1978).

One definition is that hunger is a psychological and physiological state resulting from insufficient food intake to meet immediate energy needs (NCHST, 1997). I think hunger may affect learning by decreasing the individual's receptivity and ability to profit from new experiences. According to Small World Communications survey (1996) apathy, inability to pay attention, disruptive behaviour patterns, or over-concern about food are frequently noted in teachers' comments concerning hungry children. Such behaviour may disrupt vigilance and learning experiences and reduce intellectual achievements.

Teachers have expressed awareness that children who are not meeting the challenge of learning in the classroom are coming to school hungry (NIN, 1993) and the school meals programs are initiated based on students hunger level (McIntyre & Dayle, 1992; Ryan, 1996). Researchers are also acknowledging that despite initial reports of lack of participation in breakfast programs and the need for further research (Ryan, 1996), breakfast programs lead to improved educational performance and should be a policy response to evidence of children coming to school hungry (CLF, 1997; CCSD, 1997).

The desire for increased academic performance and health is the basis for these kinds of programs (NIN, 1993; Pollitt, Leibel, & Greenfield, 1981). In a study on children and healthy eating, both children and parents identified breakfast as a particularly important meal (NPUHC, 1996). It is evident from these Canadian studies (NIN, 1993; Pollitt, Leibel, & Greenfield, 1981, NPUHC, 1996) that Canadian studies perceive a need for children to consume breakfast and not start a day hungry in order to optimize their learning potential. This perception is under scrutiny by some as it is based in part on qualitative and naturalistic science determined through observations by educators and parents (Grantham et al., 1998). There are a range of factors (Grantham et al., 1998) involved in quantitatively assessing performance of school children, such as mood, type of test, and classroom environment. These Canadian studies appear prepared to attribute value to the consensus among those that are in daily direct contact with children in regards to the importance of the impact of hunger on learning.

Purpose of the study

The purpose of this study is to investigate children's breakfast habits and relationship of breakfast, academic performance and vigilance. A questionnaire was used to explore

children's breakfast habits. Class teachers provided academic performance and behaviour conditions of the children. Children were also examined on vigilance tasks with breakfast and no breakfast conditions.

The reasons for doing this research are based on my observations and experiences as a classroom teacher. From my observations as a classroom teacher, breakfast must be an integral part of good education. It is likely that more often than not in today's fast-paced world -- with both parents in the work force or with a single parent in the work force -- that children may leave home without having eaten breakfast.

The ideal breakfast is supposed to meet one quarter of children's nutritional needs. It should have fruits, vegetables, grains and dairy products but reduced fat (Bonnie, 1998). My observations show that most of the children, who have breakfast, may not have eaten a nutritious breakfast in the morning.

Based on the findings of other studies, it is feasible to suggest that skipping breakfast impacts the behaviour of children, their school attendance, their school performance, and their overall development. When children usually skip their breakfast, their bodies conserve the limited food energy available. Their energies are first used for the maintenance of organ function, then for growth, and last for social activity and cognitive development. As a result, children reduce their activity level and become lethargic and apathetic. Their behaviour affects their social interaction, inquisitiveness, and ability to concentrate and perform complex tasks. It affects their overall cognitive functioning. (Craig, 1986).

Structure of the dissertation

Chapter 2 reviews literature on breakfast habits, effects of skipping breakfast and breakfast programs which leads to research questions. Chapter 3 discusses the methodology used in this study. Results of the research into children's breakfast habits and the impacts on their classroom behaviour and achievement are presented in chapter 4. Chapter 5 interprets the results. Key findings followed by the limitations of the study, recommendations for further research as well as suggestions for schools to promote nutritious breakfast eating habits are also discussed in this concluding chapter.

Chapter Two

LITERATURE REVIEW

Literature Review

This chapter reviews the literature on breakfast and considers parents' and teachers' perceptions of healthy breakfast, extent of the breakfast skipping and reasons for skipping breakfast. Research will be reviewed examining the effects of skipping breakfast and evaluations of breakfast programs. This leads to the development of the aims of the current research. The key findings are also summarized and discussed in tabular form in Appendix A.

There are two main perspectives on the breakfast issue. One is that breakfast is the key to a good start every morning. This is especially true for children because they are growing and changing every day. They need a nutritional boost every morning to get the learning process going, and breakfast provides that vital boost (CLF, 1997). The other view is that breakfast does not have any effect on academic performance, child behaviour or vigilance (Dickie & Bender, 1982; Lloyd et. el. 1996). First, it is important to consider what constitutes a healthy breakfast.

Characteristics of a healthy breakfast

The healthiest breakfast is a "nutritious" meal rich in complex carbohydrate including fibre, moderate in protein and low in fat, salt and sugar (sucrose). For example, Rubin (2003) suggests that a serve of fresh fruit (or 100% unsweetened fruit juice) with whole grain bread or cereal (e.g., bran) and low fat (1%) or skim milk, cheese or yogurt (low in sugar) is an ideal breakfast.

This corresponds to McGinnis' (2004) recommendation that children should follow the following Berning's three-food rule for a healthy breakfast:

1. Fruit whole or cut-up fruit, or ½ cup of orange juice. Fruit supplies carbohydrates (for energy), vitamins A and C, plus a wealth of healthy antioxidants.
2. Whole grains whole wheat toasts (look for varieties with at least 3 g of fibre per slice) or hot or cold whole grain cereal. Grains provide carbohydrates, vitamin E, folic acid, and heart-healthy fibre.
3. Two eggs, 6 to 8 ounces of low-fat yogurt, 1 cup of 1% milk, or 2 tablespoons of peanut butter. These foods provide protein which is the building block for growth and for repairing most body systems; dairy sources also add bone-building calcium.

It has been observed that some children consume energy bars instead of having a proper breakfast. Rubin (2003) claims that all "energy bars" provide energy (calories), but they do not replace the nutrients in fruits, vegetables and whole grains. Energy bars vary in weight and nutrient content. Rubin states that healthy bars are those with no more than 250 calories, 3 gm. saturated fat, 8 gm. fat and 20 gm. sugar and at least 7 gm. protein and 3 gm. fibre per serving.

Teachers' and Parents' Perception of Breakfast Issue

The social benefits of school meals initiatives, such as fewer classroom disruptions, reductions in discipline referrals, improved attendance and increased in-class participation, have been cited repeatedly by teachers, parents and students (Cooney &

Heitman, 1998; Smaller World Communications (SWC), 1996; Minnesota Department of Children, Families and Learning (MDCFL), 1998).

According to Pelican, O'Connell, and Byrd-Bredbrenner (1985), teachers report that hungry children are more likely to be apathetic, inattentive, and disruptive. Some of the teachers have observed that children experiencing learning difficulties in the classroom are coming to school hungry (NIN, 1993; McIntyre & Dayle, 1999). A telephone survey of 2,000 Canadian parents (NCHST, 1997) revealed that 77 percent of respondents felt that breakfast was the most important meal of the day. When asked to rate their level of agreement with statements about child nutrition using a ten-point scale (where 1 signifies strong disagreement and 10 represents strong agreement), survey respondents yielded an average score of 8.7 to the statement that 'children who do not eat a proper breakfast have lower concentration and a reduced ability to learn' and 7.99 to the statement that 'child hunger in the early years of school increases the likelihood of poor school performance, behavioural problems, school dropout and criminal activity'. This perception has fuelled the development of School Breakfast Programs (SBP) in Canada and US as an appropriate program response.

Researchers have also examined and reported on the observations made by parents and educators with respect to changes in classroom performance and behaviour based on implementation of school programs, specifically in North American (US & Canada) schools. In inner-city schools with a predominantly African-American population, children who participated in the SBP had lower levels of hyperactivity as well as improvements in depression and anxiety (Murphy et al., 1998). In this study, over time, an increase in participation in the SBP was associated with an increase in improvement in those parameters. Parents and teachers of students in a universal breakfast program in elementary schools reported improved student performance and behaviour following

introduction of the program (MDCFL, 1998). The schools saw a 40-50% decline in discipline referrals, which the teachers attributed to the program. In a Connecticut survey of teachers in schools whose students participated in a SBP, 87% of teachers reported that the program had a positive influence on the school day (Ragno, Andrada, 1994). Also of interest is that 91% of the teachers reported being aware of hunger in the classroom prior to introduction of the SBP, and 86% reported that the SBP significantly reduced hunger. They also reported significant improvements in students' concentration and motivation. In an evaluation of the School Food Nutrition Program of Toronto, 45% of teachers reported a change in student behaviour, including calmer, more focussed students with more energy (Brown, 1993). Teachers from Canadian schools with meals programs have consistently reported positive changes in student behaviour, decreased classroom interruptions and improved attendance. These improvements are evident in self-report data collected by evaluations of nine Canadian programs (Brown, 1993; Ryan, 1996), as well as large-scale assessments of grants-funded initiatives (SWC, 1996; Salvador, 1998).

The value of rigorously collected observations of educators and parents about this issue is now being recognized (Connors & Blouin, 1982/83; MDCFL, 1998).

Extent of skipping Breakfast

A number of studies (mostly North American) have looked at the prevalence of skipping breakfast. Various rates have been found: 4% for ages 9-19 (Resnicow, 1991), 5.1% for grades 1-3 (McIntyre, 1993), 11% for grades 1-12 (Gleason, 1995), 16% for ten-year-olds (Nicklas, Bao, Webber, & Berenson, 1993), 18% for grades 7 and 8 (Singleton & Rhoads, 1982), and as high as 38% for a sample of poor, rural children in grades 7 and 8

(Terre, Draman, & Meydrich, 1990). In 1997, a National Child Hunger Survey estimated that 42% of Canadian children do not regularly consume breakfast (Basrur, 1998) but the author does not suggest reasons for such a high proportion of children skipping breakfast.

An Australian study (Collins & Mannion, 1995) of the prevalence of breakfast consumption in Brisbane found that 4% of children (grades 3-7) from low socioeconomic suburbs had not eaten breakfast on the morning of the questionnaire. Collins and Mannion (1995) noted the lack of Australian data on this topic and there are only a few community-based breakfast programs in Australia, and none (official or unofficial) in Brisbane. These studies show a relatively small number of children skipping breakfast but the information available is over ten years old and since then the social eating habits have been changing (Basrur, 1998) and continue to change.

Reasons for skipping Breakfast

In one of the only two Australian studies (Shaw, 1998) the reasons given for skipping breakfast were almost exclusively lack of time and not being hungry in the morning. Moreover breakfast skipping was related to gender, not income, with females skipping more than three times as often as males. The other Australian study (Collins & Mannion, 1995) has not explored the reasons for skipping breakfast. While North American school nutrition programs have considered poverty to be a key issue in breakfast skipping, Shaw's findings suggest that, for Australian adolescents, skipping breakfast is a matter of individual choice.

Bidgood and Cameron (1992) found that in Canada those below the poverty line were skipping breakfast twice as often as others, but less than one percent said that they skipped due to lack of money or food. The most common reasons given for skipping were, not liking to eat particular meals and lack of time. Similarly, Singleton and Rhoads (1982) found that the most common reasons given for skipping were no time (43%) and not being hungry (42%); less common reasons included being on a diet to lose weight, not feeling good, no one to prepare food, not liking the food served, and food not being available. Thus, stated reasons have generally involved personal choice rather than availability of food.

According to the Canadian Living Foundation, 42% of Canadian children are not eating an adequate breakfast at home (CLF, 1997). In Canada, this is not only a poverty issue. Children attend school without breakfast because families are challenged by busy, rushed schedules. The researcher found that some parents go to work too early to prepare breakfast for their children; others don't enjoy breakfast themselves. In addition, many children must take school bus rides very early in the morning -- even if they eat a breakfast they may be hungry by the time they reach school.

Shaw (1998) states that too many young girls believe that if they can eliminate this meal, they can maintain some illusion of a perfect body shape and weight. Skipping breakfast is neither a sensible weight reduction measure, nor a "boon to the sleep deprived" (Shaw, 1998. p.852). Basrur (1998) and Siega, Popkin, and Carson (1998) found that with an increased number of women in the work force and increases in hours worked has altered eating patterns for families and this means that children from all types of socioeconomic backgrounds are now at risk for breakfast skipping.

Effects of skipping Breakfast

Craig (1986) argues that breakfast, the very name for this early morning meal, leads one to entertain certain notions about the nature of its effects. It breaks the fast and so presumably serves a restorative function. For example, for younger children in particular, probably at least 12 hours have elapsed since the last intake of food. One might therefore expect breakfast to have a beneficial effect.

According to Chao and Vanderkooy (1989), access to nutritious food during school hours affects school-aged children in two important ways. First, a morning or noon meal contributes to both quantity and quality of the total required intake of energy, protein, carbohydrates and micronutrients such as iron and calcium. Second, school-meals initiatives are generally believed to enhance the cognitive functioning of children, especially the speed and accuracy of information retrieval in working memory. The validity of the evidence linking breakfast consumption to optimal cognitive functioning and academic achievement remains in question to this day. Although a clear conclusion has not yet been reached because of a variety of factors which includes various age groups tested, various tests performed, various settings, different times of the tests, different nutritional status of the children tested, difficulties in having controlled conditions and above all different results obtained. Even so, the general consensus among researchers and educators is that breakfast is both important and necessary for the learning ability of children (McIntyre, 1993; CDE, 1995; Pollitt & Matt Hews, 1998). A review of literature on breakfast consumption and children's cognitive capacity have generally supported this opinion, with exception of few and an emphasis on the need for further research (Chao & Vanderkooy, 1989; Pollitt, 1995; McIntyre & Herel, 1998; Papamandjaris, 2000). The effects of skipping breakfast are discussed below in relation

to cognitive functioning, nutritional status, attendance and classroom behaviour and vigilance. They have also been summarized in table form in Appendix A.

a. Short-Term Effects on Cognitive Functioning

A number of studies have assessed the short-term effects of fasting on learning ability by examining classroom academic performance as well as standardized tests. Much of the research has not yielded a conclusive pattern of results. Pollitt and colleagues have been involved in this area and have conducted many studies. Some of their findings are summarized here. Short-term hunger (due to lack of breakfast) may have some adverse effects on emotional behaviour, arithmetic and reading ability, and vigilance while consuming breakfast may enhance a child's performance during the morning in reading and in the solution of arithmetic problems (Pollitt et al., 1978).

In another study Pollitt and his colleagues sought to determine whether any differences existed between children who received both breakfast and lunch at school and those who received lunch only. The students were in the first through third grades. No significant difference was found in attendance, but the children who received both breakfast and lunch obtained higher ratings in reading and arithmetic problems than the children receiving only lunch (Pollitt et al., 1978).

Pollitt, Lewis, Garza and Shulman (1982/83) completed two experiments assessing the effects of short-term fasting (skipping breakfast) on the problem solving performance of 9 to 11 year old well nourished children studied under controlled conditions. Both studies demonstrated that skipping breakfast had an adverse effect on a child's late morning problem solving performance and that this could be related to the child's metabolic status.

In another study (Pollitt, 1995) it was found that an overnight and morning fast had adverse effects on children's vigilance, and short-term working memory. In at-risk subjects, a morning and overnight fast had even more adverse effects on cognition, particularly the speed of information retrieval in working memory.

It is hypothesized that smaller children (<13 yrs) may be more vulnerable to the effects of overnight fasting based on their stature (Pollitt & Matthews, 1998). As such, much of the research done is conducted in elementary school children to determine the acute effects of one-time breakfast omission. The results are somewhat conflicting.

In older students, results point to a potentially increased capacity to overcome possible detrimental acute effects of breakfast omission. Several studies report a lack of significant effects of skipping breakfast on cognitive performance and mood (Cromer et al., 1990; Dickie & Bender, 1982). Many researchers did note that level of difficulty and capacity of tests to measure in-class learning may not have been appropriate and should be readjusted in future research (Dickie & Bender, 1982). Research with adolescents indicate an increased resiliency against the detrimental effects of breakfast omission (Dickie & Bender, 1982; Cromer, Tarnowski, Stein, Harton, & Thornton, 1990; Michaud, Musse, Nicolas, & Mejean, 1991; Smith, Kendrick, & Maben, 1994; Lloyd, Rogers, & Hedderley, 1996).

Lower energy consumption at breakfast resulted in poorer performance in creativity testing and voluntary endurance among 10-year-old children participating in a Swedish study (Wyon, Abrahamsson, Jartelius, & Fletcher, 1997). Hence the content of breakfast may be an important factor. Conversely, a Chilean study found no significant differences in the cognitive test performance of 8-11 year old children who were randomly assigned to breakfast or fasting conditions (Lopez, 1993).

Benton & Parker (1998) argue that brain function is sensitive to short-term variations in the availability of nutrient supplies. This indication is particularly strong for nutritionally at-risk smaller (9 to 11 year old) children. In these children, the omission of breakfast alters brain function, particularly in the speed and accuracy of information retrieval in working memory. Although no definitive conclusions are yet justified, the evidence suggests that working memory in well-nourished children is sensitive to the effects of an overnight and morning fast. If this suggestion were to be confirmed, it would have strong implications for the role of nutrition intervention in school settings - not only for developing societies but also for the industrialized world. In other words, the omission of breakfast would make a difference in the schooling process.

b. Long-Term Effects on Cognitive Functioning

Longer-term studies examine the effect of repeated episodes of breakfast omission on cognitive ability over a period of weeks or months. As such, these studies may be relevant for assessing the value of school meals programs (Papamandjaris, 2000). Research in less-developed countries has also upheld the long-term benefits of SBPs on cognitive performance. Children participating in a breakfast program at a farm school in South Africa demonstrated improvements in short-term memory tasks, class participation and positive peer interaction over a one year period (Richter, Rose, & Griesel, 1997). A review of studies (Dani, Burrill & Demmig-Adams, 2005) to examine long term effect of nutrition on mental functions of children concluded that consumption of breakfast has positive impacts on child's learning capability and behaviour. A randomized trial on the effects of a SBP in Jamaica revealed that students receiving a full breakfast over the school year demonstrated improvements in attendance and nutritional status (Powell, Walker, Chang, & Grantham, 1998). Younger children participating in the study also demonstrated improvements in their mathematical ability.

Another study conducted in Jamaica reported higher attendance rates and mathematical ability among students receiving breakfast over a one month period (Simeon, 1998).

Several studies have examined the impact of the US SBP, a legislated national program to reduce child hunger, on cognition and classroom performance. Results are typically from elementary schools. In Massachusetts, the introduction of the SBP positively impacted the academic performance of low-income school children (Meyers, Sampson, Weitzman, Rogers, & Kayne, 1989). In Minnesota, conversion of the targeted SBP available to needy children to a universal SBP available to all children resulted in an increase in composite math and reading percentile scores over a three year period (MDCFL, 1998). In Pennsylvania and Maryland, participation in the SBP, both targeted and universal, was associated with improved academic and social functioning (Murphy, Pagano, Nachmani, Sperling, Kane, & Kleinman, 1998). Additionally, increased participation in the SBP over time was associated with significant increases in these areas. In Washington State, serving a school breakfast to high school students resulted in increased capacity of the students to perform assigned tasks (Bro, Shank, Williams, & McLaughlin, 1994).

Researchers (Pollitt et al., 1995) in Guatemala examined the cognitive performance of children who had received either a low-protein/low-energy supplement or a high-energy/high-protein supplement for the first two years of life at least ten years following cessation of supplement delivery. Subjects who had received the higher energy supplement performed significantly better on assessments of cognition. Pollitt (1995) argues that the availability of meals programs in schools throughout the academic year increases the probability that children will eat breakfast and improve their educational status. In a slightly different type of study (Pollitt, Jacoby, & Cueto, 1996) in Peru,

students receiving breakfast over a one month period demonstrated improvements in attendance and vocabulary.

Although most of the evaluations have generally upheld the value of the SBP, caution needs to be exercised in generalizing these results to broader populations given that the SBP operates primarily in economically disadvantaged areas. It must also be recognized that non-participation in the SBP is not equivalent to breakfast omission. The observed improvements in academic performance and social functioning indicate that the SBP has helped American children regardless of the factors contributing to its effectiveness (Pollitt & Matthews, 1998).

c. Effects of Nutritional Status

Much of the research examining the effects of breakfast on cognition has been done by comparing the effects on adequately nourished versus malnourished children. In Jamaica, studies have illustrated the differential effects of breakfast omission on adequately nourished versus malnourished children. In three studies, the cognitive performance of undernourished and at risk children was negatively affected by the omission of breakfast, whereas the performance of the well-nourished controls was not affected (Chandler et al., 1995). Research on Peruvian school children from poverty stricken areas has demonstrated similar results. Nutritionally at-risk boys from poverty stricken centres were more adversely affected by breakfast omission as compared to their not-at-risk counterparts in tests of discrimination and short-term memory (Cueto, Jacoby, & Pollitt, 1998). Many of the researchers reporting these results cautioned against making direct inferences to populations that do not have the same characteristics of under-nourishment.

The performance of the undernourished children on the verbal fluency test improved when they were given breakfast, whereas that of the adequately nourished children did not (Chandler, Walker, Connolly, & Grantham, 1995).

In brief, the performance of undernourished children was adversely affected by skipping breakfast on the tests of cognition, discrimination, short term memory and verbal fluency while no change in performance was observed for well nourished children when they skipped their breakfast.

d. Effects on Attendance and Classroom Behaviour

The value of SBPs is not limited to improvements in the cognitive functioning of participating children. Research has also linked participation in school breakfast initiatives with reported improvements in the classroom learning environment, which includes increased attendance, fewer classroom disruptions and improved classroom behaviour.

The link between eating breakfast and an improved classroom environment, while evident in a number of evaluation studies, has not been established. A comprehensive review of literature, (Shaw, Racine, & Offord, 1999) concluded that, on balance, breakfast programs did not foster consistent positive effects on classroom behaviour; in many instances, teachers recording changes in classroom behaviour were unable to differentiate between children who did/did not eat breakfast. Moreover, the recorded in-class benefits of breakfast program, when present, were often minimal. For example, attendance in 11 elementary schools in Metropolitan Toronto increased by 0.1% one year after the commencement of school meals programs (Brown, 1993). Nevertheless, it does appear that, in many instances, the benefits of SBPs may extend well beyond improvements in the cognitive abilities of children.

Although the research is by no means conclusive, reported improvements in classroom behaviour, school attendance, tardiness and readiness to learn point to an important social dividend of school meals programs that should not be overlooked. By fostering a school environment that is more conducive to learning, breakfast programs benefit the entire student body, not just malnourished, disadvantaged participants.

e. Effects on Vigilance

Consuming breakfast does have not only a positive impact on academic performance, but it also has a significant impact on behaviours like vigilance that lead to higher academic performance (Brown, 1993). Vigilance can be defined as the process of maintaining attention or the ability to sustain attention (Stroh, 1971). Lack of breakfast affects arithmetic and reading ability as well as physical work output. Children who eat breakfast make fewer errors on continuous-performance task (vigilance task) and do better on arithmetic tests (Shaw, 1998).

Consumption of breakfast has also been found to improve performance in a vigilance task (continuous performance test) among well-nourished 9 to 11 year old US children (Conners & Bluoin, 1982/83). Furthermore, an experimental study (Pollitt, 1995) revealed that scanning speed in short-term memory tests was faster under the breakfast condition than under the no-breakfast condition. Consumption of breakfast consistently benefits the cognitive performance of under-nourished children, particularly in working memory tests.

Benton and Sargent (1992) examined the hypothesis that blood glucose levels influence memory. The performance on two memory tests was to be quicker when breakfast had been taken, suggesting that the ability to retrieve memories had been facilitated. This study influenced blood glucose levels by either giving or not giving breakfast, and then

examining the impact of this procedure on two tests of memory. The conclusion was that it was the time taken, rather than the number of errors, that was associated with blood glucose. The time taken to search memory and retrieve items reflects many factors, including vigilance, alertness and motivation. Breakfast increases glucose, which in turn improves cholinergic functioning giving rise to improvements in mental performance.

Time may also be a factor. For example, Pollitt et al. (1982/83) found that in the late morning, school children are more likely to make errors on a picture identification task (Matching Familiar Figures Test) when they have skipped breakfast. On the other hand, in another study, breakfast or no breakfast did not affect vigilance on the Continuous Performance Test (Dickie & Bender, 1982).

Thus, the effects of skipping breakfast depend on numerous factors including children's socioeconomic background, availability of breakfast, age of children, kinds of tests administered (classroom academic performance, vigilance tasks, social behaviour, verbal fluency, memory etc), timing of breakfast (early morning, late morning etc), content of breakfast, controlled conditions etc. Various research studies have administered different tests in variable controlled situations on different socioeconomic groups and different age groups, and have not provided a uniform set of data and results. Similarly, Bellisle (2004) concluded that breakfast omission sometimes has deleterious effects, has no effect or even has beneficial effects depending on what the task is, when it is performed after breakfast, the child's intelligence quotient, the child's age and nutritional status, and the child's habit of having or omitting breakfast. These considerations are needed in future research.

Breakfast Programs

Breakfast programs are very common in US and Canada while only a few programs exist in the remote regions of Australia as discussed earlier. The following section discusses the characteristics of populations in need of breakfast programs, the need for breakfast programs and the evaluation of breakfast programs.

Characteristics of populations in need of Breakfast Program

Breakfast programs should strive to maintain a degree of universality and therefore to be available to all school children rather than be targeted towards a specific group (MDCFL, 1998). The identification of children who might be at greater risk is important to ensure delivery of the programs to vulnerable populations. Clearly, children who do not consume an energy providing or nutritionally adequate breakfast represent children who are at risk. The percentage of children in Canada who reportedly do not consume breakfast has been estimated to be in the range of 6-42% depending on the site of the program (Basrur, 1998; McIntyre, 1993). Breakfast skipping and inappropriate meal practices are therefore relatively prevalent in Canada (McIntyre & Horbul, 1995). Classification of these children based on measurable state of nourishment and socioeconomic and lifestyle factors is nonetheless difficult (Siega et al., 1998).

With respect to socioeconomic status and lifestyle factors, there is no clear indication of a combination of factors that can identify children in a developed country at risk. Child and family poverty has increased steadily in Canada (CACP, 1999; CCSD, 1999) and there is evidence that poverty can deny children's access to proper nutrition (Evers, 1995). Poverty is sometimes cited as a reason for the initiation of breakfast programs (McIntyre & Dayle, 1992). There is not a clear indication that low income status is linked to breakfast skipping in Canada (McIntyre & Horbul, 1995; NIN, 1993).

Based on the difficulty of classifying breakfast skippers and children, who are at risk, the universality of Canadian breakfast programs is an important component. It allows all children at risk to have access to morning nutrition. Additionally, participation in breakfast programs is higher when the program is universal (Gleason, 1995). The need for evaluation of existing programs and for a large body of research to be conducted in the classroom setting must also be recognized. Such research should include an in depth assessment of reasons for potential non-participation of children at risk. The value of breakfast programs for children to increase cognition will only be further supported with continued research both in the classroom and the clinical setting. Hence the importance of universal breakfast programs is still in question.

Need for Breakfast Programs

The goals of breakfast programs take into account the overall well being of the child, both from a health and from an educational standpoint. The school-based meals programs aim to alleviate a child's hunger and as such can improve a child's academic performance while at the same time contributing to the nutritional status of the child (NIN, 1993). For the Toronto Board of Education, a stated specific goal is to alleviate hunger and thereby increase academic achievement (Brown, 1993).

A model illustrating the need for breakfast programs and their subsequent objectives was outlined and refined (McIntyre & Herel, 1998). Hunger relief is the sole objective listed when hunger is the perceived need. The model, in its clarity, fails to elucidate the direct relationship parents and educators see between hunger and academic achievement. For parents and educators, a stated goal of alleviation of hunger is often synonymous with the goal of improved cognition and performance (Brown, 1993).

Depending on their make-up, breakfast programs may provide an opportunity for socialization as well as nutrition education. Programs that incorporate such holistic goals are most likely positively affecting the well being of the students (SCAN, 1994).

Evaluation of Breakfast Programs

There is a lack of data regarding the evaluation of breakfast programs, and as such, assessment of success with respect to alleviation of hunger and improvement in cognitive ability is difficult. With respect to academic performance, much of the evidence is qualitative. In Toronto, 45% of school staff reported a change in student behaviour as a result of the program, including calmer, more focussed students with greater energy (Brown, 1993). Similar reports of better behaviour are reported from studies in Ottawa, where teachers also report improved academic performance (Ryan, 1996). The Canadian Council on Social Development states that SBPs improve attitudes and attentiveness, leading to increased concentration and productivity (CCSD, 1997). To support these results, there is a need for much further documentation of the effects of breakfast on cognition in children.

More information is required on the participation of students in the programs and the degree to which hunger is being alleviated. An evaluation of the Toronto Board of education program for 1992 revealed that participation in the breakfast program was around 18% for primary students (Brown, 1993). The estimated number of children who do not eat breakfast and therefore are in need of a program has varied depending on the site of the program. In Toronto, it has been estimated that up to 42% of children are not regularly eating a nutritious breakfast before going to school (Basrur, 1998). Figures from Foodbank WA -- which coordinates Breakfast Clubs in Western Australia by donating food -- show that school involvement has jumped from 7 in 2001 to over 140 in 2005 (FBWA, 2005). The current number of breakfast programs is 182 (Ms.

Irene Verteramo, Coordinator of Perth Metropolitan School Breakfast Programs at Foodbank WA, personal communication, 28th October, 2005). The results of the programs are considered to be outstanding by the program coordinators, with truancy reduced, improved behaviour and sociability and better health and educational outcomes (FBWA, 2005). Consequently, coordinators of breakfast programs must be encouraged to perform self-assessment of the effectiveness and benefits.

With respect to increasing a sense of community and delivering nutrition education, again further documentation is required. At this time, high self-reported satisfaction rates from volunteers and people working within the programs indicate the presence of a sense of community (HSPCVC, 1999; SCAN, 1994).

The SBPs have been in existence for many years. The main outcome variables have been nutritional status, school attendance, school achievement, vigilance and classroom behaviour. Benefits have been found in all these variables (Simeon & Grantham, 1989). In one of the breakfast studies, (Simeon & Grantham, 1989) it was found that a control group was not adversely affected in any cognitive test when breakfast was omitted. In contrast, the previously malnourished group was adversely affected in fluency (a measure of generation of ideas and motivation) and coding (visual short-term memory). Relative to the control children they were also adversely affected in arithmetic. In conclusion, under controlled conditions previously severely malnourished children were adversely affected in a number of cognitive functions when they skipped breakfast.

The US Congress in 1966 (Public Law 89-642) created the SBP for the primary purpose of offering a morning meal to low-income children who would otherwise have none. The findings reported in the US, have noticed possible improvements in academic performance, attendance, and vigilance associated with SBP participation among high-risk elementary school children living in poverty or near poverty (Meyers et. el. 1989).

Providing free or subsidized meals will not help those who choose not to eat them (as the research quoted earlier found 42% not being hungry or have no time to eat). Instead, skipping might be decreased by teaching the importance of eating breakfast, as well as building self-esteem and informing adolescents about sound means of weight control. Although all WA schools are expected to implement the curriculum framework and therefore teach about healthy eating as a part of the Health and Physical Education program but there is a need to emphasize this more often.

At issue is whether breakfast can improve academic performance and vigilance even if the child's habitual nutrient intake meets the child's nutrient requirements. The studies in Jamaica and Peru confirmed the advantage of school meals programs: they increase the attendance rate of children. In addition, the study in Peru found that the benefits of breakfast are particularly noticeable among nutritionally at-risk children (Pollitt, 1995).

Conclusion

Although most of the research conducted to date points to a link between breakfast and cognitive functioning, further studies are needed to look at the value of breakfast for enhancing child nutrition and academic performance. There is a need for more comprehensive evaluations of the impacts of skipping breakfast. While a number of studies have identified the beneficial impacts of breakfast on their intended recipients, the paucity of evaluation research on such initiatives makes it impossible to formulate, let alone defend, generalizations about breakfast's usefulness. Most of the research to date has focused on tracking outcomes, such as improved academic performance, rather than the sideline issues contributing to these results.

Further research is also needed on issues such as quality of breakfast, social context of breakfast, and gender differences. There is a lack of Australian research on breakfast and its relationship with academic performance and vigilance. One of the only two Australian research is only looking at the frequency of breakfast skipping (Collins & Mannion, 1995) while the other one is also exploring the relationship of breakfast, academic performance and vigilance (Shaw, 1998). There are only a few recent research studies on breakfast while there have been changes in social eating patterns during this time. Prevalence of breakfast skipping amongst not-at-risk groups should also be explored. Quality of breakfast is an important factor as the children having an less nutritious breakfast may not perform better. Effects of breakfast skipping on particular areas like classroom behaviour (often observed by teachers), vigilance and academic performance should be taken into account consistently to reach a uniform set of results. The timing of breakfast (early morning, late morning etc), gender differences as well as effects on different age groups of children also needs to be looked at.

In conclusion, the review of studies on the short-term and long-term effects of hunger and feeding does not yield a uniform set of data (Papamandjaris, 2000). Hence further studies are required to look at this very important issue from different perspectives. Therefore, this present research seeks to address some of these issues by examining the content of breakfast consumed, the frequency of skipping breakfast, some aspects of the social context of breakfast consumption, feelings of the children on the day if they skipped breakfast, gender differences, and reasons for skipping breakfast as well as effects of breakfast status on the academic performance and vigilance in the Australian setting with reasonably well nourished children. These issues lead to the forthcoming research questions.

Research Questions

Breakfast Habits

The following six research questions will explore why children skip their breakfast, frequency of skipping, gender differences, content of breakfast, some social impacts and the feelings of children on the day, they skip breakfast.

1. How frequently do children skip their breakfast?
2. What are the reasons children of Upper Primary Grades in Western Australia give for skipping their breakfast?
3. Are there any gender differences in breakfast habits?
4. What is the content of breakfast children usually have?
5. What are the impacts of eating in the company of other family members on the breakfast habits of children?
6. How do children feel on the day, when they skip breakfast?

Relationship between Academic Performance and Breakfast Routine

This question will explore the relationship between the school academic performance and the usual breakfast routine of children.

7. Is there a relationship between Breakfast and Academic Performance in children of Upper Primary Grades in Western Australia?

Relationship between Vigilance, Behaviour and Breakfast

This question will explore the relationship between vigilance and the breakfast condition of children on that particular day of the tests administered as a part of this research.

8. Is there a relationship between Breakfast, Vigilance and Behaviour in children of Upper Primary Grades in Western Australia?

Chapter 3

METHODOLOGY

Methodology

This chapter details and discusses the methodology used in this study. The participants and settings are described followed by the study design. The procedure and instruments used to collect data are described and discussed. This chapter concludes with a discussion of the methods used to analyze the data.

Participants

Much of the research on the short-term impacts of breakfast omission has been conducted on elementary school children (up to age 13), as it is hypothesized that the cognitive performance of smaller children may be more vulnerable to the effects of overnight fasting (Pollitt & Matthews, 1998).

The participants comprised 72 students of 5th, 6th and 7th grades from two schools in Western Australia. The sample included 30 male and 42 female students. Table 3.1 shows the distribution of students across grades and schools.

Table 3.1 Statistics of Subjects

	<u>Year 5</u>		<u>Year 6</u>		<u>Year 7</u>		Total
	M	F	M	F	M	F	
School 1	8	7	4	9	3	4	35
School 2	5	6	3	6	7	10	37
Sub Total	13	13	7	15	10	14	M=30, F=42
Total	26		22		24		72

Settings

The questionnaires and vigilance task were conducted at the respective schools of the participants. The questionnaire was completed during regular class lessons, while the vigilance tasks (SART) were administered on an individual basis in a room specially put aside for the research approximately one and a half hours into the school day. Children were grouped according to whether or not they had breakfast on the day of the study. In this way the study is naturalistic. Children were not randomly assigned to 'breakfast' and 'no breakfast' groups.

Design of Study

	<u>All students</u>	
Breakfast Habits	x	
	<u>Breakfast</u>	<u>No Breakfast</u>
Classroom Behaviour	x	x
Vigilance	x	x
	<u>Usual Breakfast</u>	<u>Usual No Breakfast</u>
Academic Performance	x	x

Instrumentation

Data were obtained in three ways.

- Breakfast habits/Questionnaire: All participants completed a questionnaire (n=72) which explored breakfast habits of the children. A copy of the questionnaire is given in Appendix B.
- Academic Performance & Behaviour: The class teachers entered the classroom performance/grades based on first semester/start of second semester evaluations. The class teachers also entered the behaviour conditions of the children based on the observations in a prescribed Pro-forma. A copy of the pro-forma is given in Appendix C.
- Vigilance Tasks: The participants with breakfast and no breakfast conditions were then examined on vigilance tasks (SART) one and a half hour after the

school started. Participants in the 'no breakfast' group had not eaten before testing.

Breakfast Habits/Questionnaire

A questionnaire comprising twelve questions was used to explore breakfast habits of the children under study which included data on demographic characteristics, breakfasts skipping frequency, content of breakfast, when and what is the first meal of the day, if they skip breakfast, reasons of skipping breakfast, effects of skipping breakfast and social impacts on breakfast routine. Demographic questions included in the questionnaire were related to year at school, date of birth and gender. All the relevant information about their breakfast routine was retrieved through this questionnaire.

Frequency of Breakfast Skipping: Question 1 explored how many children skip breakfast and how often they skip it.

Content of Breakfast: It is important to know what they have for breakfast if they do. Hence Questions 2 to 4 explored the content of breakfast they had.

First Meal of the Day if Breakfast Skipped: Question 5 was intended to find out the timing of eating if they skip their breakfast at home in the morning. Questions 6 to 8 again accessed what they eat if they eat on the way to school, during recess or lunch if they skip breakfast at home.

Effects of Breakfast Skipping: Question 9 explored how children feel on the day they skip their breakfast.

Reasons for Skipping Breakfast: Question 10 explored the reasons why children skip their breakfast.

Impacts of eating in the company of other family members on Breakfast Routine:

Question 11 explored the impacts of eating in the company of other family members in regards to breakfast eating at home. Question 12 explored mothers' routine of employment or home duties as a possible factor of skipping breakfast.

Academic Performance & Behaviour

Class teachers provided class assessment (A-F) for each participating child in English, Mathematics and Science based on their First Semester and part of Second Semester academic performance. Class teachers also provided a rating (1-3) for specific behaviours of each participating child on the testing day. A pro-forma with already printed names of the students was provided to the class teachers who entered the class performance and behaviour. Refer to Appendix C for further details.

Vigilance Tasks

Sustained Attention to Response Tasks (SART) were conducted with all 72 children.

The ability to sustain attention is an important factor affecting performance in many tasks (Rueckert & Grafman, 1996; Wilkins, Shallice, & McCarthy, 1987). The main focus of research with the SART was to investigate the performance of children with the ability to sustain attention.

Participants in this research were tested approximately one and a half hours into the school day. The following three vigilance tasks were completed by students.

1) Score: This task determined concentration of the children under study. The researcher played an audio tape and the children were asked to count the number of scoring sounds

they hear. The children's ability to count to 15 was checked. The children did a practice first.

2) Creature Counting: This task examined alertness of the children under study. In this task, children were asked to count the creatures in their burrows on cards while switching counting down and sometimes counting up on each down and up arrow. The children's ability to count to 15 was checked. The children did a practice first. The score was calculated and the time spent was recorded as well.

3) Code Transmission: This task evaluated short-term memory of the children under study. The researcher played a tape, which had a very long list of numbers between 1 and 9. Children had to find certain numbers like a code. Once the child heard two 5's, he/she had to tell the number that came right before these two 5's. The children's ability to count to 15 was checked. The children did a practice first.

The raw scores from these three vigilance tasks (SART) were converted into standardized scores using the tables provided in the 'Tests of Everyday Attention for Children' (TEA-Ch) manual.

These three tasks as a part of Sustained Attention to Response Tasks are designed to measure a person's ability to withhold responses to infrequent and unpredictable stimuli during a period of rapid and rhythmic responding to frequent stimuli (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). The performance is interpreted as a reflection of the ability to sustain attention, which is defined as "the ability to self-sustain mindful, conscious processing of stimuli whose repetitive, non-arousing qualities would otherwise lead to habituation and distraction to other stimuli" (Robertson et al., 1997).

Procedure

The consent to participate was obtained in advance from the Principals of the selected schools, the parents and children (copies of letters and consent form are given in appendices C, D & E) before conducting the sessions. Two children were randomly selected as reserves in case students were absent on the day. Data were collected in two phases: First, all the participants completed the questionnaires. The researcher read each question of the questionnaire aloud for any students who might have difficulty reading the questionnaire. An opportunity was provided at the conclusion of the questionnaire for questions or clarification. The administration of the questionnaire took approximately half an hour in each class.

The class teachers were provided with the pro-forma for entering the appropriate behaviour conditions of the children that morning and their classroom performance/grades based on first semester and part of second semester assessments. The names and dates of birth were filled in for teachers, so that the only children with parental permission were included. These students were later given Vigilance Tasks (SART).

Data Analysis

Academic performance, vigilance and classroom behaviour data were analyzed using the SPSS Statistical Package to investigate the relationship between breakfast, academic performance and vigilance in school aged children. Multi-variant analysis of variance was undertaken to interpret results from the questionnaires, teachers' assessment and vigilance tasks.

It was hypothesized that the students, who had breakfast on the day of testing, would perform better on vigilance as compared to the students who had not had breakfast on that day. Also, as previous research suggests that the effect is greater for younger children, it was hypothesized that the effect would vary with grade levels. Hence each of the vigilance tasks scores and classroom behaviours were analysed by grade (3) x breakfast (2) ANOVA. As two schools were used in the study, school (2) was added to test for school differences. Academic performance was similarly analysed, but breakfast/no breakfast was designated by the children's usual breakfast habits (calculated from responses to the breakfast questionnaire) rather than whether or not they had breakfast on the day of the testing. Homogeneity of variance was met in most cases. Considering the number of individual tests, significance level was set at .01. Chi Square was used to test gender differences for the questionnaire data. Pearson Correlations were used to test the relationship between variables in the study.

Chapter 4

RESULTS

Results

This chapter presents the results of the research into children's breakfast habits and the impacts on their classroom behaviour and academic achievement. The results of the breakfast questionnaire are described, followed by the analyses of the vigilance, academic performance and behaviour data. Means and standard deviations for each variable are given together with the results of ANOVA tests of significance and correlations among variables. The findings and their significance are discussed in the following chapter.

Breakfast Questionnaire (Breakfast Habits)

The questions in the breakfast questionnaire examined students' self reported information about their usual breakfast habits which included: the frequency of skipping breakfast, content of breakfast & breakfast alternatives, reasons for skipping breakfast, effects of skipping breakfast and social impacts on breakfast routine. The results are set out as frequency and percentages of students' responses for each question separately.

As previous Australian research has indicated gender differences in breakfast habits, gender was considered in the present study but there were no significant gender differences in the frequency of responses found using Chi square tests of association. Hence the findings are presented and interpreted without reference to gender.

Frequency of Breakfast Skipping

The Frequency of Breakfast Skipping was examined by responses to Q 1. How often do you skip your breakfast? Table 4.1 shows that more than half of the children (56.9%) at least sometimes skip their breakfast with a small percentage 5.6% indicating that they almost always skip breakfast.

Table 4.1 Frequency of responses to Q1. How often do you skip your breakfast?

	Response	Frequency	Percentage
1	Almost Never	31	43.1
2	Sometimes	28	38.9
3	Often	9	12.5
4	Almost Always	4	5.6
	Total	72	100.0

Content of Breakfast

The content of breakfast was examined in terms of the main components of each child's usual breakfast, using three questions.

Children's responses to Q 2. When you eat breakfast what do you usually eat for breakfast? are given in Table 4.2. All children answered this question in the positive suggesting that all of the children, even those who 'almost always' skip breakfast, do eat breakfast from time to time. Toast and cereal were the popular breakfasts, with 94.5% of

children eating one or other of these when they have breakfast. These are high carbohydrate foods.

Table 4.2 Frequency of responses to Q2. What do you usually eat for breakfast?

	Response	Frequency	Percentage
1	Cereal	29	40.3
2	Toast	39	54.2
3	Bread	1	1.4
4	Biscuits	3	4.2
5	Nothing	0	0.0
	Total	72	100.0

The responses to Q 3. If you eat toast or bread, what do you put on it? (Table 4.3) revealed that 44.5% children put cheese, peanut butter, vegemite and egg on their toast or bread. These contain a quantity of protein which contributes to a nutritious breakfast. The responses of the remainder of the children (55.5%) suggest that they may have little or no protein in their breakfast. The results shown in this question could be a bit misleading because some of the children might be eating egg without bread or toast while some might be having protein in form of milo or milk.

Table 4.3 Frequency of responses to Q3. If you eat toast or bread, what do you put on it?

	Response	Frequency	Percentage
1	Butter	12	16.7
2	Cheese	4	5.6
3	Jam	11	15.3
4	Peanut Butter	14	19.4
5	Egg	4	5.6
6	Honey	4	5.6
7	Vegemite	10	13.9
8	Nothing	13	18.1
	Total	72	100.00

Children's breakfast drink was examined in Q 4. What drink do you usually have for breakfast? Milo was the most popular drink with a total of 40% children drinking milo or milk. Some of the children (13.8%) drink tea or coffee, which is not recommended for children of this age because of the presence of caffeine.

Table 4.4 Frequency of responses to Q4. What drink do you usually have for breakfast?

	Response	Frequency	Percentage
1	Tea	5	6.9
2	Coffee	5	6.9
3	Milk	9	12.5
4	Water	11	15.3
5	Juice	13	18.1
6	Milo	20	27.8
7	Nothing	9	12.5
	Total	72	100.0

Alternatives to Breakfast

The timing of the first food of the day was examined if children skipped their breakfast through question 5. Children's responses to Q 5. If you don't have breakfast at home, when do you eat your first food of the day? are given in Table 4.5. Out of those who skip breakfast, almost one third (29%) eat nothing until recess or lunch time suggesting that some children may go for more than 15 hours without a meal which is alarming.

Table 4.5 Frequency of responses to Q5. If you don't have breakfast at home, when do you eat your first food of the day?

	Response	Frequency	Percentage
1	On the way to school	15	20.8
2	On arriving at school	6	8.3
3	During recess	17	23.6
4	During lunch time	4	5.6
	Total	43	59.7

Content of Alternatives to Breakfast

The content of alternatives to breakfast at home was also examined in terms of the main components of each child's usual alternative to breakfast, using three questions.

Responses to Q 6. What do you usually eat if you eat on the way to school or on arriving at school? revealed that biscuits look a favourite food on the way to school, which is easy to eat and manage in this situation. This suggests that children are not likely to have a nutritious breakfast on the way to school.

Table 4.6 Frequency of responses to Q6. What do you usually eat if you eat on the way to school or on arriving at school?

	Response	Frequency	Percentage
1	Cereal	0	0.0
2	Toast	11	15.3
3	Bread	2	2.8
4	Biscuit	15	20.8
5	Nothing	15	20.8
	Total	43	59.7

The responses to Q 7. What do you put on your toast or bread if you eat on the way to school or on arriving at school? showed that only 18% children put cheese, peanut butter, vegemite or egg on toast or bread. This suggests that the rest may not be having sufficient proteins in their breakfast while having breakfast on the way to school.

Table 4.7 Frequency of responses to Q7. What do you put on your toast or bread if you eat on the way to school or on arriving at school?

	Response	Frequency	Percentage
1	Butter	7	9.7
2	Cheese	1	1.4
3	Jam	4	5.6
4	Egg	0	0.0
5	Honey	2	2.8
6	Vegemite	2	2.8
7	Peanut Butter	10	13.9
8	Nothing	13	18.1
	Total	39	54.2

The responses to Q 8. If you eat on the way to school or on arriving at school, what drink do you have with it? demonstrated that almost three quarters of those who have breakfast on the way to school (72%) drink water or nothing because managing to have a drink other than water on the way to school seems hard.

Table 4.8 Frequency of responses to Q8. If you eat on the way to school or on arriving at school, what drink do you have with it?

	Response	Frequency	Percentage
1	Tea	0	0.0
2	Coffee	2	2.8
3	Milk	0	0.0
4	Water	11	15.3
5	Juice	9	12.5
6	Milo	0	0.0
7	Nothing	17	23.6
	Total	39	54.2

Effects of Breakfast Skipping

It was also investigated how children feel on the day when they skip their breakfast through Q 9. How do you feel on days when you have not had your breakfast? The more frequent responses were being sleepy, inactive and forgetting lesson as a consequence of skipping breakfast on the day. These are important findings as this is based on the first hand information provided by the respondents themselves regarding the short-term after-effects of skipping breakfast.

Table 4.9 Frequency of responses to Q9. How do you feel on days when you have not had your breakfast?

	Response	Frequency	Percentage
1	Sleepy	10	13.9
2	Inactive	7	9.7
3	Anxious	1	1.4
4	Feel headache	4	5.6
5	Dizzy	3	4.2
6	Depressed	1	1.4
7	Understand the lesson with difficulty	4	5.6
8	Forget the lesson	6	8.3
9	Feel as if ants are crawling under my skin	2	2.8
10	Feels nothing	0	0.0
	Total	38	52.8

It was realized later that only negative possibilities were offered in this question. Some children might feel happy, fresh etc. when they skip their breakfast.

Reasons for Breakfast Skipping

The reasons for skipping breakfast were also explored through Q 10. Why do you skip your breakfast? The main reasons were not being hungry, getting up late and not liking to eat in the morning. Reasons offered for skipping mainly had to do with personal choice and convenience, rather than with dieting and concern about body shape.

Table 4.10 Frequency of responses to Q10. Why do you skip your breakfast?

	Response	Frequency	Percentage
1	Never skip breakfast	31	43.0
2	Get up late	4	5.6
3	Usually not hungry	21	29.1
4	Spend too much time on other things	0	0.0
5	Want to lose weight	1	1.4
6	I don't like the food	2	2.8
7	Have no time to eat	6	8.3
8	Don't like to eat in the morning	3	4.2
9	Dieting	0	0.0
10	Food not available	2	2.8
	Total	70	97.2

Impacts of eating in the company of other family members on Breakfast Routine

The impacts of eating in the company of other family members on breakfast habits were also looked into through Q 11. Do you eat breakfast usually ... Sometimes this could be a factor for skipping breakfast in the morning. Having breakfast with whole family could encourage children to regularly have breakfast.

Table 4.11 Frequency of responses to Q11. Do you eat breakfast usually ...

	Response	Frequency	Percentage
1	On my own	32	44.4
2	With some of my family members	35	48.6
3	With all of my family members	4	5.6
4	With friends	0	0.0
5	Don't eat	1	1.4
	Total	72	100.0

More than half (54.2%) of the children have their breakfast with some or all of their family members.

Mothers' schedule was also examined assuming that usually mothers are the carers of their children at home if they are housewives or are not working outside home. The responses to Q 12. What does your mother do?, when combined with question 1, revealed that more than half of students' mums either work outside home in day time or are employed outside home on night shift (54.8%), are frequent breakfast skippers. Statistically this difference is not significant.

Table 4.12 Frequency of responses to Q12. What does your mother do?

	Response	Frequency	Percentage
1	Home duties	30	41.7
2	Employed outside home in the day time	40	55.6
3	Employed outside home on night shift	2	2.8
	Total	72	100.0

The Relationship between Breakfast, Vigilance, Academic Performance and Classroom Behaviour

This part of the research examined the effect of breakfast (or no breakfast) on vigilance tasks and children's regular breakfast habits on their classroom behaviour and achievement. A summary of the findings is presented as tables of means and standard deviations of each of the variables. ANOVAs (Breakfast x School x Year) were carried out to test for the effect of the breakfast condition on each variable and if there were interactions with School or Grade. Where interactions were present, post hoc (Scheffe comparisons) analyses were performed.

The Vigilance tasks tested alertness, concentration and memory. There were no effects involving School suggesting no differences between the two schools in the study. As expected there was a significant interaction for Breakfast and Year, but only for Concentration, $F(2,60)=5.9$ ($p<.01$). There were no main effects for Breakfast or interactions for the other vigilance variables.

Means and standard deviations of each of the variables on vigilance tasks separated by Breakfast condition are given in the Table 4.13 and for the Interaction in Figure 4.1.

Table 4.13 Means and Standard Deviations of Scores on Vigilance Tasks

	<u>Breakfast</u>		<u>Non-Breakfast</u>	
	Mean	SD	Mean	SD
Concentration Task	10.68	2.80	8.50	3.52
Alertness (Accuracy) Task	11.06	2.94	10.20	3.04
Alertness (Timing) Task	8.10	3.28	9.22	2.79
Short-Time Memory	10.71	2.81	7.95	2.99

Note The raw scores on SART (vigilance) tasks were converted into age scaled standardized scores which range from 1-19 with higher value as 19.

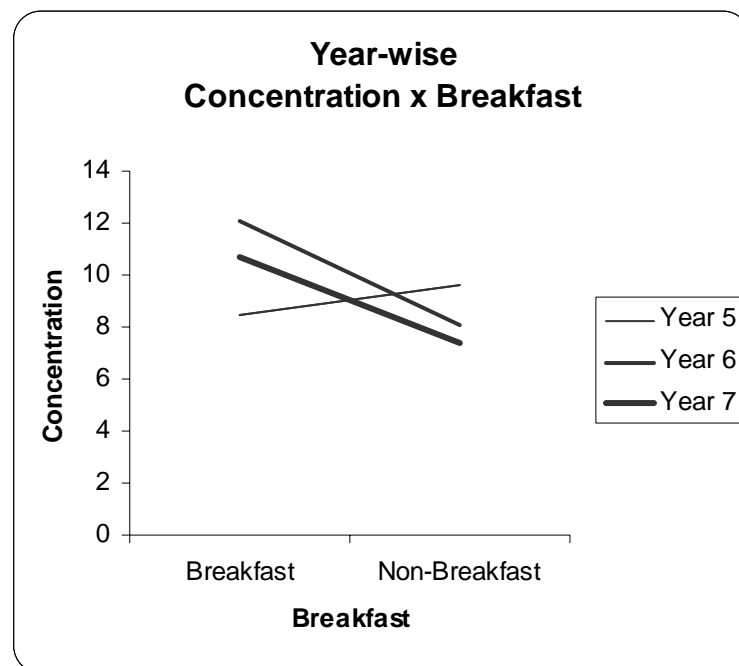


Figure 4.1 Breakfast x Year Interaction for Concentration

A post hoc analysis, Simple Effects for Concentration, showed that the year 6 and 7 groups who had eaten breakfast performed significantly ($p < .05$) better in the concentration task than their classmates who had not eaten breakfast that day. There was no difference found for the year 5 group. In addition the year 5 group who had eaten breakfast performed lower than the year 6 group who had had breakfast. Since the scores were adjusted for age, this result is surprising and suggests there are other factors influencing children's concentration. Further details of the analyses are in Appendix G.

Means and standard deviations of each of the variables on academic performance separated by usual Breakfast routine are given in the Table 4.14. Surprisingly the results for academic performance are not in the expected direction, but differences are not significant.

Table 4.14 Means and Standard Deviations of Scores on Academic Performance

	<u>Usual Breakfast</u>		<u>Usual Non-Breakfast</u>	
	Mean	SD	Mean	SD
English Performance	2.32	1.01	3.02	1.19
Maths Performance	2.45	1.06	2.90	1.26
Science Performance	2.26	1.00	2.95	1.30

Note The score on academic performance range from A-F. This was converted into numeric score with the range from 1-6, with 6 being high performance.

Means and standard deviations of each of the variables on teachers' behaviour observations separated by Breakfast condition are given in the Table 4.15 and for the Interaction in Figure 4.2.

Table 4.15 Means and Standard Deviations of Scores on 'Teachers' Behaviour Observations

	<u>Breakfast</u>		<u>Non-Breakfast</u>	
	Mean	SD	Mean	SD
Laziness	1.3	0.5	1.2	0.5
Sleepiness	1.1	0.3	1.3	0.6
Depressed	1.1	0.3	1.2	0.4
Anxiousness	1.2	0.4	1.2	0.4
Lack of short-term Memory	1.4	0.5	1.4	0.5
Truancy Behaviour	1.06	.25	1.05	.22

Note The score on behaviour observations range from 1-3 whereas 1 represents not observed, 2 observed sometimes while 3 observed often.

There was a significant interaction for school and breakfast/non-breakfast $F(1,60)=6.7$ ($p=.01$) in sleepiness (see Figure 4.2). More details of post hoc analysis (Scheffe comparisons) are given in the Appendix G. There were no other differences for classroom behaviour.

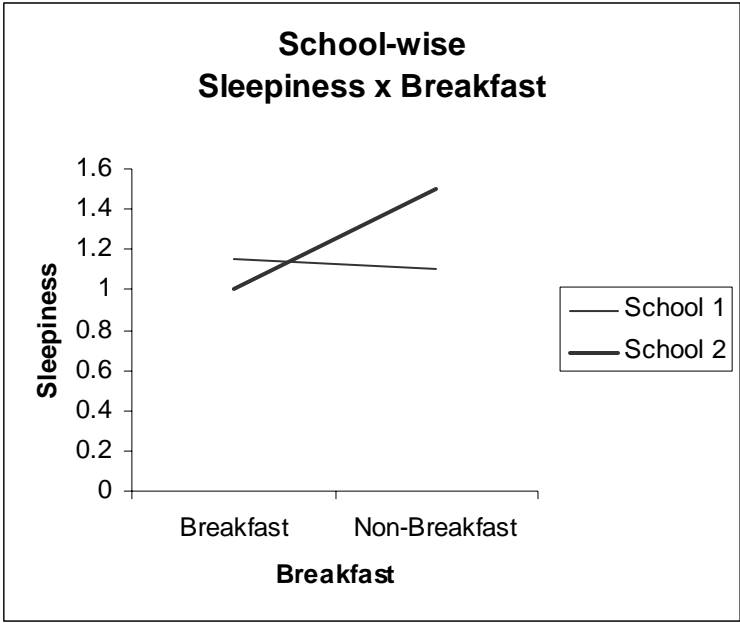


Figure 4.2 Breakfast x School Interaction for Sleepiness

The expected difference was observed for school 2. Details of ANOVA are given in Appendix H.

Inter Correlations of Variables

Pearson correlations were carried out to examine the relationship among vigilance tasks, academic performance and behaviour conditions which are given in tables 4.16, 4.17 and 4.18.

Table 4.16 Correlation among Vigilance Tasks

		Concentration Task	Alertness Task (Accuracy)	Alertness Task (Timing)
Alertness Task (Accuracy)	Pearson Correlation	.35(**)		
	Sig. (2-tailed) p	.002		
Alertness Task (Timing)	Pearson Correlation	.156	.42(**)	
	Sig. (2-tailed) p		.000	
		.191		
Short-term Memory Task	Pearson Correlation	.50(**)	.44(**)	.31(**)
	Sig. (2-tailed) p	.000	.000	.009

** Correlation is significant at the 0.01 level (2-tailed). n=72

Pearson correlations were carried out to examine the relationship among vigilance tasks. The above matrix shows that there is a moderate relationship amongst the standardized scores of Concentration, Alertness, Accuracy and Short-term Memory. No significant relationship was observed between Concentration Task and Alertness (timing). On the whole this shows that if children have lack of short term memory, then they have a

tendency of short concentration span as well as they tend to be less alert.

Table 4.17 Correlation among English, Maths and Science Performance

		English Performance	Maths Performance
Maths Performance	Pearson Correlation	.69(**)	
	Sig. (2-tailed) p	.000	
Science Performance	Pearson Correlation	.76(**)	.76(**)
	Sig. (2-tailed) p	.000	.000

** Correlation is significant at the 0.01 level (2-tailed). n=72

The above correlation matrix shows that a strong correlation exists amongst English, Maths and Science performances. Hence children tend to perform similarly in each of these three learning areas.

Table 4.18 Correlation among Teachers' observations about Students' Behaviour

		Lazy	Sleepy	Depression	Anxious	Short-term Memory
Sleepiness	Pearson Correlation	.25				
	Sig. (2-tailed) p	.037				
Depression	Pearson Correlation	.16	.50(**)			
	Sig. (2-tailed) p	.183	.000			
Anxiousness	Pearson Correlation	.25	.35(**)	.70(**)		
	Sig. (2-tailed) p	.038	.003	.000		
Short-term Memory	Pearson Correlation	.08	.26	.07	-.04	
	Sig. (2-tailed) p	.517	.026	.542	.745	
Truancy Behaviour	Pearson Correlation	.11	.03	-.09	-.11	.33(**)
	Sig. (2-tailed) p	.363	.807	.440	.341	.004

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed). n=72

There is a weak relationship between laziness, sleepiness and anxiousness. A weak relationship does exist among sleepiness and lack of short-term memory while there is a moderate correlation between sleepiness and depression. There is a weak relationship

between sleepiness and anxiousness. There is also a strong correlation between depression and anxiousness as well as a weak correlation exists between lack of short-term memory and truancy behaviour. This shows that teachers tend to rate students similarly to some extent.

Re-examining the Quality of Breakfast

The findings suggest that it is not only whether or not children have breakfast that might influence their vigilance, academic performance and classroom behaviour. In order to explore the possible impact of breakfast quality on these variables, the children's responses to the Breakfast Questionnaire were re-examined to generate an indicator of quality of a child's usual breakfast.

Firstly, the food was categorized into two groups; food with proteins and food with carbohydrates. Based on this breakfasts were also categorized into two groups; breakfasts that contained proteins and/or carbohydrates were categorized as nutritious and the breakfast with negligible amount of proteins and/or carbohydrates were categorized as less nutritious. Data used for this categorization is given in Appendix I.

PROTEIN FOODS: Egg, Peanut Butter, Vegemite, Milk, Milo, Cheese etc.

CARBOHYDRATE FOODS: Toast, Cereals, Bread, Juices etc.

Overall Summary of Quality of Breakfast

As we can see from the table below, the proportion of those having a nutritious breakfast on the way to school is almost negligible. More than half of the students (53%) having a less nutritious breakfast are those who have their breakfast on the way to

school. Hence in order to have a nutritious breakfast, children should be encouraged to have breakfast at home before leaving for school.

	<u>Morning Breakfast</u>	<u>On the way to school</u>
Nutritious Breakfast	37 (97%)	1 (3%)
Less nutritious Breakfast	35 (47%)	39 (53%)

Summary of Quality of Breakfast (Breakfast Group only)

The table below tells us that even those having breakfast regularly (55%) might not have the desired positive impacts on their academic performance, behaviour or vigilance because they are consuming less nutritious breakfast.

	<u>Morning Breakfast</u>
Nutritious Breakfast	14/31 (45%)
Less nutritious Breakfast	17/31 (55%)

Overall Breakfast Quality Status

This is important to note a significant percentage of children (32%), who usually have a nutritious breakfast (well nourished) but sometimes skip breakfast because of various reasons, could be a part of a not-at-risk group. Whereas those who regularly have a less nutritious breakfast (24%) may be at risk. This complicates the situation and shows a need for further research considering quality of breakfast as an important factor.

<u>Non-Breakfast group</u>		<u>Breakfast group</u>	
Less nutritious	Nutritious	Less nutritious	Nutritious
18 (25%)	23 (32%) (not-at-risk)	17 (24%)	14 (19%)

More details of the breakfast quality are explained in Appendix I.

In brief, the results indicate that most of the children at least sometimes skip their breakfast; those who do have breakfast at home often consume a less nutritious breakfast; those who have breakfast on the way to school or on arriving at school almost always consume a less nutritious breakfast; and the reasons offered for skipping had to do with personal choice and convenience rather than with dieting and concern about body shape. Fewer significant relationships were found between breakfast, academic performance and vigilance. One of the reasons for this could be that the quality of breakfast needs to be considered. The findings from these results will be discussed in the discussion chapter.

Chapter 5
DISCUSSION

Discussion

This concluding chapter draws together and interprets the results of the quantitative analysis of the data. The findings are summarized under each research question. Then follows the limitations of the study, recommendations for further research as well as suggestions for schools to promote nutritious breakfast eating habits.

This research aimed to investigate the content of breakfast consumed and the frequency of skipping breakfast as well as reasons for skipping breakfast in upper primary school children. The relationship between breakfast and academic performance and vigilance was also explored. The participants in this study comprised 72 students of 5th, 6th and 7th grades from two schools in Western Australia. All participants completed a questionnaire about breakfast habits and three vigilance tasks. The teachers provided their observed information about children's behaviour. The findings are summarized and discussed here under the main research questions.

Breakfast Habits

The questions in the breakfast questionnaire examined students' self reported information about their usual breakfast habits. The following six research questions have explored why children skip their breakfast, frequency of skipping, gender differences, content of breakfast, some social impacts and the feelings of children on the day, they skip breakfast.

1. How frequently do children skip their breakfast?

According to the responses in this study, more than half of the students (56.9%) at least sometimes skip their breakfast with a small percentage (5.6%) indicating that they almost always skip breakfast. Previous research has found a wide range of responses in regards to frequency of skipping breakfast. A large number of studies (Collins & Mannion, 1995; Gleason, 1995; McIntyre, 1993; Nicklas et. al., 1993; Resnicow, 1991; Singleton, 1982) show relatively small number of children (4%, 11%, 4.6%, 16%, 4% and 18% respectively) skipping breakfast but the information available is over ten years old and since then the social eating habits have been changing. The findings of the current study are backed up by a relatively recent study of Basrur (1998) which found that 42% children do not regularly consume breakfast. Further, the actual wording of the question may lead to variations in responses.

Initial findings of the research by Wendy Oddy, of the Telethon Institute of Child Health Research at the University of Western Australia, reported in the *Sunday Times* front page story on 16 Oct. 2005, estimated that as many as 20,000 children were leaving home hungry (Spagnolo, 2005). Dr Oddy's estimates were based on an institute survey of 2000 WA teenagers, which showed that nearly 10 per cent were not fed before school. Of those who were, a proportion admitted eating junk food such as lollies, chips, pizza and pies for breakfast (Oddy, personal communication, 17th October, 2005).

2. Are there any gender differences in breakfast habits?

There were no significant gender differences found in the current study. This is contrary to the finding of Shaw (1998) that females skip breakfast more than three times as often

as males but Shaw's research focussed on adolescents where body image issues and dieting are more prevalent. Gender was not reported in many studies. One possible reason for not reporting gender in most of the studies could be that gender was not significant and hence not reported.

3. What is the content of breakfast children usually have?

In the current study, content of breakfast was examined which revealed that 20.8 % students have their breakfast on the way to school but the proportion of those having a nutritious breakfast on the way to school is almost negligible. It is important to note that 97% of those who have nutritious breakfast have their breakfast at home while only 3% of the nutritious breakfast eaters have their breakfast on the way to school. More than half (53%) of the less nutritious breakfast eaters are those who have their breakfast on the way to school. Hence in order to have a nutritious breakfast, children should be encouraged to have breakfast at home before leaving for school. Even those having breakfast regularly (55%) might not have the desired positive impacts on their academic performance, behaviour or vigilance because they are consuming breakfast that is not nutritious.

A significant percentage of children (32%), who usually have a nutritious breakfast but sometimes skip breakfast because of various reasons, may not have the detrimental effects of breakfast skipping. Whereas those who regularly have a less nutritious breakfast (24%) may have a risk of negative effects. This group may be undernourished if they have similar eating pattern for the other timings of the day otherwise they are at least hungry for some part of the day. This complicates the situation and opens doors for further research. None of the available previous research has so far investigated the quality of breakfast issue. Hence future research could focus on the quality of breakfast and may be an indicator of less nutritious eating at other times.

4. What are the reasons, children of Upper Primary Grades in Western Australia give for skipping their breakfast?

The main reasons for skipping breakfast were: not being hungry, getting up late and not liking to eat in the morning. Reasons offered for skipping mainly had to do with personal choice and convenience, rather than with dieting and concern about body shape. This is backed up by the findings of Bidgood & Cameron (1992) and Shaw (1998). Similarly, Singleton and Rhoads (1982) found that the most common reasons given for skipping were no time (43%) and not being hungry (42%); less common reasons included being on a diet to lose weight, not feeling good, no one to prepare food, not liking the food served, and food not being available.

5. What are the impacts of eating in the company of other family members on the breakfast habits of children?

The present study found no significant impacts of eating in the company of other family members on the breakfast habits of children. There were no gender differences.

Contrary to the above findings, in one of the breakfast studies (Crockett & Sims, 1995), it was found that males were more likely to eat alone, but females were more likely to skip. Perhaps these female skippers not only had the desire to skip, but also the opportunity. In other words, social context, in particular parental supervision, might be a determining factor. Hence it is important that policy makers understand and recognize the changes in our social eating environment that may put all children at risk.

6. How do children feel on the day, when they skip breakfast?

In the present study, more frequent responses about the children's feelings were being sleepy, inactive and forgetful as a consequence of skipping breakfast on the day. These

are important findings as this is based on the first hand information provided by the respondents themselves regarding the short-term after-effects of skipping breakfast. None of the available research has so far surveyed children to find out their feelings on the day they skip their breakfast.

Relationship between Academic Performance and Breakfast Routine

This question explored the relationship between the school academic performance and the usual breakfast routine of children.

7. Is there a relationship between Breakfast and Academic Performance in children of Upper Primary Grades in Western Australia?

There was no significant relationship found between breakfast and academic performance as recorded in this study. The Pearson correlation among the academic performance measures showed that children tend to perform similarly in each of the three learning areas as per teachers' assessment, but none were related to whether or not students regularly had breakfast.

These findings are similar to the findings of Cromer et. al. (1990), Dickie & Bender, (1982), Lloyd et. al. (1996), Lopez (1993) and Vaisman et. al. (1996), which found no relationship between breakfast skipping and academic performance. The studies of MDCFL (1998), Meyers et. al. (1989), Murphy et. al. (1998), Pollitt et. al. (1996), Powell et. al. (1998), Simeon et.al. (1998), and SWC (1996) found a link between skipping breakfast and academic performance which is contrary to the findings of the current study. Some studies have found mixed results and partly support the current study which include: Chandler et. al. (1995), Cueto et. al. (1998), Grantham McGregor et.al. (1998),

Pollitt et. al. (1981), Pollitt et.al. (1996), and Wyon et. al. (1997). These studies have found some negative impacts of skipping breakfast on academic performance while at the same time also found some evidence of having no relationship between skipping breakfast and academic performance in certain tests.

Reasons for these contradictory results could be that all these research are using a large variety of tests at different length of times for different age groups; some with small samples while others with large samples and none of them considered the quality of breakfast issue.

Relationship between Vigilance and Breakfast

This question explored the relationship between vigilance and the breakfast condition of children on that particular day of the tests administered as a part of this research.

8. Is there a relationship between Breakfast and Vigilance in children of Upper Primary Grades in Western Australia?

There was no significant relationship found between breakfast and vigilance tasks except concentration. It seems that children from year 6 and 7 (12-13 Years old) have a bigger concentration span if they have breakfast while year 5 showed no differences. The Pearson correlation showed that if children have a lack of short term memory, then they have a tendency of short concentration span as well as they tend to be less alert. Post hoc analysis showed that the year 5 group who had eaten breakfast performed significantly ($p < .05$) lower than the year 6 group in the concentration task who had had breakfast. This is contrary to the findings of Pollitt and Matthews (1998) that smaller children are more vulnerable to the effects of overnight fasting.

These findings are backed by Dickie & Bender (1982) where no differences were observed in vigilance on omission of breakfast. The findings of the current study are also partly supported by Grantham McGregor et.al. (1998), Michaud et. al. (1991), Shaw et. al. (1999) and Smith et. al. (1994). Smith (1998) observed no effects of breakfast condition on sustained attention tasks. The following studies have results contradictory to the current study: Benton et. al. (1998), MDCFL (1998), Powell et. al. (1998), Ragno et. al. (1994), Shaw (1998) and SWC (1996). Ragno et. al. (1994) found a positive influence of having breakfast on children's attentiveness, energy level, concentration and motivation.

Reasons for these contradictory results could be that all these research studies are using a large variety of tests at different length of times for different age groups; some with small samples while others with large samples and none of them considered the quality of breakfast issue.

Limitations

The study had a number of limitations which are discussed below:

Students were divided into breakfast and no breakfast groups on their having/not having had breakfast on that day. The study could be conducted in a more controlled (clinical) situation where one group can be provided breakfast on a particular time monitoring the quality of breakfast at the same time, while the other group could be tested prior to having breakfast on the testing day.

In the questionnaire, the alternatives offered may have limited the students' responses. For example, question 1 could be improved by including more specific alternatives, such as once a week, twice a week and so on. It was realized later that some children might not have circled egg in questions 3 and 7 of the breakfast habits questionnaire only because they are not putting egg on toast or bread. There is a possibility that they might be eating only egg. Hence egg should also be included in questions 2 and 6 of the questionnaire.

The quality of breakfast was examined later in this study. The study was not set up to do this, only post hoc analysis revealed that this could be an important factor. The questions included in the questionnaire did not give an accurate picture of breakfast quality. So this study can not make a firm conclusion about quality.

The study had to rely on the students' self-reported information which may not be accurate. Some of the children may not have remembered what they ate or been unable to match what they did eat with items in the questionnaire. If the study is conducted in a boarding school or clinic, then the information may be validated through observation as well.

Recommendations for Further Research

This study recommends that the following should be considered for further research in this area.

Another avenue of research could be boarding schools where breakfast and no breakfast conditions could be properly monitored and children's vigilance/behaviour can be observed in many informal situations. Research also needs to look into the both short term and long term effects of skipping breakfast. Parents could complete questionnaire to triangulate information from students. The sample should be wider and include various age groups.

In order to determine the quality of breakfast, students could be given a breakfast log book for one week. Students should be advised to write everything and the quantity they eat or drink in the morning. This study has only considered proteins and carbohydrates. In future studies, all important nutrients including proteins, carbohydrates, glucose, fats, vitamins, minerals, water etc. should be taken into account while determining the quality of breakfast. This will give an accurate picture of breakfast quality. Then quality should also be considered while investigating any relationship between breakfast, academic performance and vigilance as children having less nutritious breakfast have not been a focus of previous studies.

What primary schools can do regarding Breakfast issue?

Based on the findings of the current study, while discussing the breakfast issue, the frequency of skipping or having breakfast may not be the only issue. The quality of breakfast (nutritious/less nutritious) may also be an important factor. See Table 5.1 for an overall School Plan. Four specific recommendations are detailed below.

1. Awareness about healthy eating at school

It is important to identify whether breakfast is a big issue in a particular school, why children skip breakfast and what they think would motivate them to eat it more often. A 'breakfast group', which includes children, parents, teachers, school canteen staff and other interested members of the school community can organize the collection of this information and select appropriate strategies to promote breakfast. Schools may create awareness about healthy eating through curriculum, the school environment, and partnerships with parents and the wider community.

2. Breakfast Programs

The literature review concluded that breakfast programs may increase the probability that children will eat breakfast. There may be a benefit for children where time is a particular constraint, such as when travel time to school is significant, where students participate in early morning extra curricular activities, and for children who are not hungry first thing in the morning.

The introduction of school breakfast programs as a single strategy to increase breakfast consumption is unlikely to make a significant impact. Breakfast programs are unlikely to appeal to the vast majority of students who currently skip for reasons other than food availability. Organizing school breakfast days could make a difference in creating awareness about the benefits of eating breakfast and eating quality breakfast.

Foodbank WA sponsored 182 School Breakfast programs in Western Australia that are apparently successfully working with reduced truancy, improved behaviour and educational improvement, but the outcomes are wide ranging and there is a need for systematic research and evaluation of the programs.

3. Changing the school timetable

Changing the school timetable so that the first break is earlier in the school day may assist students who are not motivated by hunger before classes begin. Children should be encouraged to eat fruits and vegetables during morning break.

4. Curriculum

Children need knowledge and skills to make their own breakfast. This could be integrated into the Health and Physical Learning Area outcomes which emphasise building knowledge, skills and attitudes in unison to change health behaviours. Curriculum should include basic nutrition, including the value of breakfast, body image and self esteem, and address time management and organizational skills relating to breakfast. Learning how to prepare a variety of healthy foods can be more effective than just learning about the importance of good nutrition.

Table 5.1 Overall School Plan

Primary schools can take the following specific measures in order to create awareness about eating quality breakfast in the morning.

Classroom Activities	School Environment	Partnerships with parents and the wider community
<ul style="list-style-type: none"> • Teachers should have an increased focus on health, nutrition and breakfast in their classroom activities. • Teachers should be provided breakfast information and be encouraged to use it in the curriculum. • Breakfast recipe books should be developed and trialling of recipes in class should be organized. • Students should be encouraged to deliver breakfast messages in the form of poetry and skits in assembly. 	<ul style="list-style-type: none"> • Events like ‘School Breakfast Day’ should be organized to promote healthy breakfast amongst students and community. • A breakfast eating area should be allocated on school grounds. • The timetable should be changed to enable an earlier snack time in the morning. • Breakfast may be provided at the school canteen. • School canteen’s breakfast menu should be regularly assessed in regards to nutrients. • Nutritional quality of all foods sold at the school canteen should be improved. 	<ul style="list-style-type: none"> • Short information pieces should be included on the importance of breakfast in the school newsletter. • Parent education forum should be organized on the issue of breakfast. • Parents should be involved in class activities and special events that promote healthy eating. • Breakfast provision to all students by food companies may be organized for one day/week period.

Conclusion

More than half of the students (56.9%) at least sometimes skip their breakfast with a small percentage (5.6%) indicating that they almost always skip breakfast. The reasons offered for skipping mainly had to do with personal choice and convenience, rather than with dieting and concern about body shape. Children mostly consume less nutritious breakfast if they do not have breakfast at home, if at all they do. Hence in order to have a nutritious breakfast, children should be encouraged to have breakfast at home before leaving for school.

The study found little relationship between breakfast, academic performance and vigilance. Quality of breakfast was identified as a possible factor that should be taken into account in future research.

In conclusion, the review of literature and the findings of the current study do not yield a uniform set of data on the short-term or long-term effects of breakfast skipping. Further there is a lack of Australian research on breakfast issue. Hence further studies are required to look at this very important issue from different perspectives particularly considering the quality of breakfast. More refined research would be able to address these complex issues.

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APPENDICES

The appendices contain:

A: Summary of Breakfast Studies

B: Breakfast Habits Questionnaire

C: Class Teachers' Assessment/Observation Pro-forma

D, E and F: Letters and Consent Form sent to Principals and/or parents

G: Details of Analyses

H: ANOVA Results for Interactions

I: Quality of Breakfast

Appendix A

SUMMARY OF BREAKFAST STUDIES

SHORT TERM EFFECTS

Study	Subject & Grade/Age	What was tested	Method	Result
<i>Conners et. el. 1982/83</i>	10 children, aged 9-11 y.	Breakfast and cognitive performance	Cognitive tests involved continuous performance tasks and arithmetic testing.	Subjects performed better on the arithmetic tests and on the continuous performance tasks with breakfast, although not all differences were reported as significant.
<i>Pollitt et. el. 1981</i>	22 girls and 10 boys, mean age 10.4 y	Breakfast omission and speed/accuracy in a problem-solving situation	Blood tested. Cognitive testing using the matching familiar figures test (MMFT), the continuous performance task (CPT), and the Hagen Central-Incidental task (HCI).	Statistically significant differences between the no-breakfast and the breakfast groups for Lambda 2-hydroxybutyrate, lactate, and free fatty acids. Breakfast omission had a negative effect on accuracy of responses in problem solving, but had a beneficial effect on immediate recall in short-term memory.
<i>Pollitt et. el. 1982/1983 Study 1</i>	23 girls, 9 boys, aged 9-11 y	Breakfast and problem solving performance	Cognitive tests included the matching familiar figures test (MFFT), the Hagen-Central Incidental test (HCI), vocabulary tests, and an intelligence test. Glucose, lactate, Lambda 2-hydroxybutyrate and free fatty acid levels were measured.	Glucose values differed in the morning significantly between the NBR and the BR conditions. Errors in the hard section of the MFFT were greater in the NBR condition. Errors in the HCI were greater in the BR condition.
<i>Pollitt et. el. 1982/1983 Study 2</i>	20 girls, 19 boys, aged 9-11 y	Breakfast and problem solving performance	Cognitive tests included the matching familiar figures test (MFFT), the Hagen Central-Incidental test (HCI), vocabulary tests, an intelligence test, and two short-term memory tests. Glucose and insulin levels were measured.	Glucose and insulin values differed significantly in the morning between the NBR and the BR conditions. Errors in the hard section of the MFFT were greater in the NBR condition. Errors in the HCI were greater in the BR condition.
<i>Wyon et. el. 1997</i>	195 children, aged 10 y from five different schools.	Breakfast and cognitive capacity	All students were tested during both high calorie and low calorie conditions. Tests used were addition, multiplication, grammatical reasoning, number checking, and creativity. A questionnaire regarding their impression of hunger. Mood and physical endurance was also assessed.	Significant and positive effects of the larger breakfast were found in the creativity test and in voluntary endurance. In tests of addition, error rates were negatively correlated to energy intake and in number checking, work rate increased with energy intake. No significant effects were found in multiplication or grammatical reasoning. Students reported feeling hungrier following the lower energy breakfast.

<i>Vaisman et. el. 1996</i>	569 children, aged 11-13 y	Breakfast and breakfast timing and cognitive functions	Cognitive tests (Rey Auditory-Verbal Learning Test) measuring learning and memory: immediate recall, delayed recall, recognition, memory of temporal order, ability to cope with interferences, and visual memory.	For session one, no differences in cognitive test results were observed between students who did or did not consume breakfast on the test day. For session two, following 14 days of breakfast delivery, children were separated into groups of those who had eaten breakfast at school, those who had eaten at home, and those who had skipped breakfast. Children who had eaten the school breakfast, served close to the testing time, performed significantly better on the cognitive tests compared to children who had either eaten at home or who had not eaten at all. There were no differences between breakfast skippers and those children who ate breakfast at home.
<i>Dickie and Bender, 1982</i> Study 1	227 children, mean age 12.5 y and 260 children, mean age 15.3 y.	Performances of habitual breakfast-eaters and breakfast-skippers	Students filled out a questionnaire to determine breakfast and snack consumption. Students were tested using a cancellation test.	No significant differences were observed between breakfast eaters and non-breakfast eaters in terms of percent change of test scores from before and after lunch.
<i>Dickie and Bender, 1982</i> Study 2	55 and 53 students, mean age 17 y and 16.2 y respectively.	Effects of breakfast skipping on habitual breakfast-eaters	Cognitive function was tested using two short-term memory tasks, a simple addition test, and sentence verification.	No differences were observed based on the omission of breakfast in habitual breakfast eaters.
<i>Lloyd et. el. 1996</i>	14 female and 2 male, mean age 26.1 y	Breakfast composition and morning mood and cognitive performance.	Subjects rated their mood and underwent a battery of cognitive tests: visual information processing, motor speed, free recall, and simple reaction time.	There was no significant effect of breakfast omission on performance.
<i>Michaud et. el. 1991</i>	319 students, mean age 16 y.	Breakfast-size and short-term memory, mood, concentration, and blood glucose	Short-term memory, concentration, mood, and blood glucose were measured.	Blood glucose was not affected by breakfast energy content. Short-term memory performance increased with greater energy consumed at breakfast; however, performance on concentration test decreased. Breakfast energy level did not affect mood.
<i>Smith et. el. 1994</i> Study 1	48 university students.	Breakfast or caffeine and mood, reaction time, and vigilance.	Mood and physiological changes including heart rate were assessed. Cognitive tests were conducted for reaction time, response, and vigilance.	After 1 h, there were no effects of breakfast on mood, but mood was negatively affected at 2 h in the no breakfast and cereal/toast group. There were no effects of breakfast condition on performance of the sustained attention tasks.

<i>Smith et. el. 1994</i> Study 2	48 university students (different subjects from Study 1).	Breakfast or caffeine and mood and performance of memory tasks.	Mood and physiological changes including heart rate were assessed. Cognitive tests conducted were free recall, delayed recognition memory, logical reasoning, and semantic processing.	After 2 h, subjects who consumed breakfast reported feeling more quick-witted and proficient compared to those who did not eat breakfast. After 1 h, breakfast eaters had greater recall as compared to non-breakfast eaters, and at 2 h this effect just failed to reach significance. In memory recognition, both at 1 h and 2 h after breakfast, breakfast eaters had fewer errors. There were no differences based on breakfast condition in logical reasoning or semantic processing.
<i>Benton et. 1998</i> Study 1	33 university students, mean age 21.3 y.	Blood glucose concentrations and memory test performance.	Blood glucose was measured. Subjects underwent two memory tests: spatial memory and word list.	Time taken to complete both tests was greater in the fasted state but number of errors was not influenced by breakfast condition. In the fasted state, blood glucose was significantly correlated to time taken to complete the spatial memory test. In the fed state, there was a significant negative correlation between blood glucose and number of errors on the spatial memory test.
<i>Benton et. 1998</i> Study 2	80 university students, mean age 22.6 y.	Systematically manipulated glucose levels and short-term memory decay and information processing capacity.	Subjects underwent short-term memory testing using the Brown-Peterson task.	Breakfast consumers performed significantly better regardless of drink status. Subjects who were fasted but who consumed the glucose drink also showed practice effects. Subjects who were completely fasted did not show practice effects.
<i>Benton et. 1998</i> Study 3	184 university students, mean age 22 y.	Breakfast and memory and intelligence performance.	Subjects underwent memory and intelligence testing.	There was no effect of drink or breakfast on abstract reasoning. In memory tests, fasted subjects who consumed the glucose drink recalled more words than those subjects who consumed the placebo. In the placebo group, those who consumed breakfast recalled more words than those who did not eat breakfast.

LONG TERM EFFECTS

Study	Subject & Grade/Age	What was tested	Method	Result
<i>MDCFL, 1998.</i>	Students in 6 elementary schools	Universal breakfast program and student performance, attendance, and classroom behaviour.	Student performance was monitored in various areas including discipline, test scores, and attendance. Teacher and parent perceptions of the program were also assessed.	Participation in the universal breakfast program, around 75% of students, was much greater than the state average of 12% in schools with a targeted breakfast program. Schools saw an average of 40-50% decline in discipline referrals which administrators attributed to the breakfast program. Overall, there was a general increase in composite math and reading percentile scores following the three-year period in participating students.
<i>Meyers et. el. 1989</i>	Children in grades 3-6 in 16 elementary schools	Participation in the SBP and test scores, tardiness, and absenteeism.	Students were tested using the Comprehensive Tests of Basic Skills (CTBS), a standardized achievement test, and their rates of tardiness and absenteeism were assessed.	Between the two testing times, increases in overall CTBS scores and language sub-scores, were significantly greater for program participants than non-participants. Increases in mathematics and reading approached significance. Tardiness rates decreased for participants and increased for non-participants. Controlling for other factors, the SBP contributed positively to CTBS scores and negatively to tardiness and absence rates.
<i>Murphy et. el. 1998</i>	Children (1627) from three schools. A subset of students (133) from grades three or higher and their parents' participated in questionnaires .	Participation in a school breakfast program and psychosocial and academic functioning	Students' grades in math, science, social studies, and reading as well as their absence and tardiness rates were assessed. Students' depression and anxiety were assessed and their degrees of psychosocial dysfunction as estimated by their parents. Teachers' evaluations were also measured using the Conners Teacher Rating Scale-39.	Prior to the UF program, average participation in the breakfast program was 15%. This rose significantly to a participation rate of 27% following introduction of the UF program. Before the UF program, cross-sectional results show that students grades in math were related to breakfast program participation, but grades in science, social studies, and reading were not related. Children who ate breakfast at school often had significantly lower symptom scores on child-, parent-, and teacher-reported questionnaires. After participation in the UF program, cross-sectional results show that math grades were still related to breakfast participation. Interview measures of depression and anxiety failed to reach significance for comparisons between levels of participation. With respect to longitudinal results, children who increased their participation in the breakfast program were more likely to improve their math grades

				compared to children who maintained or decreased participation. Children who increased their participation also decreased their rates of tardiness and absence. Additionally, these children also demonstrated greatest improvements in child-reported depression and anxiety, as well as hyperactivity reported by teachers.
<i>Powell et. el. 1998</i>	407 undernourished school children and 407 adequately nourished children	Breakfast and attendance, nutritional status, and achievement in arithmetic, spelling, and reading	All subjects underwent testing at the beginning of the school year. The intervention lasted the entire school year when the subjects were retested. Subjects were tested in reading, spelling, and arithmetic. Subjects' attendance rate and weight and height were also measured.	Children who received breakfast showed small yet significant improvements in both nutritional status and attendance compared with those who received the placebo. Younger children who received breakfast also showed improvement in arithmetic.
<i>Simeon et. el. 1998</i>	Grade 7 children, aged 12-13 y	School meal and achievement, attendance, and physical growth	School achievement was assessed using the Wide Range Achievement Test, which tested arithmetic, spelling, and reading.	Provision of breakfast resulted in higher achievement in arithmetic and higher attendance rates. The achievement in arithmetic was independent of attendance and weight gain. There were no differences in weight gain between groups.
<i>Pollitt et. el. 1996</i>	Students in grades 4 and 5 in 10 schools	School breakfast program and nutrient intake, cognitive ability, academic performance, and attendance rates	Teachers recorded attendance rates of all students. Cognitive tests examined digit discrimination, coding and digit span tests, reading comprehension, vocabulary, and mathematics. Socioeconomic status was also assessed.	The inter-group difference for attendance was slight but significant, with greater attendance in the breakfast group. The only difference in test results was in the vocabulary test, with the breakfast group showing a positive yet not significant effect of treatment.

EFFECTS OF NUTRITIONAL STATUS

Study	Subject & Grade/Age	What was tested	Method	Result
<i>Chandler et. El. 1995</i>	100 adequately nourished and 100 mildly undernourished grade 3 and 4 children.	The short-term effects of breakfast consumption on the cognitive performance of mildly undernourished versus adequately nourished children.	Children underwent cognitive tests including: visual searching, working memory, verbal fluency, and information processing speed.	Undernourished children performed better in verbal fluency when they received breakfast. No other significant treatment effects were noted.
<i>Simeon et. El. 1989</i>	Three groups of children, aged 9-10.5 y	Breakfast and cognitive function of children of differing nutritional status.	A battery of cognitive tests was used to assess computational skills, auditory and visual short-term memory, idea generation, verbal comprehension, and problem solving ability, including the Matching Familiar Figures Test (MFFT) to assess problem solving skills and the Hagen Central-Incidental task (HCI) to assess visual short-term memory and attention to task irrelevant information.	Results: There were no differences between stunted and previously malnourished children when breakfast was omitted and these groups were combined to assess differences when compared to the control group. The malnourished groups had lower fluency (generation of ideas and motivation) and coding (visual short-term memory) scores whereas the control group had higher arithmetic scores when breakfast was omitted. When separated into wasted and non-wasted groups, the wasted group was adversely affected in the digit-span-backward items test, wasted children in the malnourished group were affected in efficiency of problem solving (MFFT), and wasted children in the control group were affected in digit span forwards. Overall, the cognitive functions of children who were stunted or previously malnourished as well as wasted were the most affected by the omission of breakfast.
<i>Grantham-McGregor et. El. 1998</i>	100 Undernourished and 100 adequately nourished children, 8-11 years.	Breakfast consumption and in-class cognitive function and behaviour.	Cognitive testing, including visual search, digit span, verbal fluency, and information processing was conducted. Behaviour, including attention span and talking without permission, was assessed through classroom monitoring.	Nutritional status (undernourished versus nourished) had no effect on cognitive status. Undernourished children performed significantly better following consumption of breakfast. Changes in classroom behaviour depended on the school. Better organized schools saw improved attention with breakfast whereas in poorly organized schools the behaviour deteriorated.

<i>Cueto et. El. 1998</i>	54 elementary school boys, aged 10 y	Breakfast and cognitive processes as a function of nutritional status and history	Cognitive tests were performed using a computer and assessed number discrimination, vocabulary, non-verbal IQ, reaction time, stimulus discrimination, and short-term memory. Blood glucose was measured.	The at-risk group was adversely affected by the omission of breakfast on the stimulus discrimination and short-term memory test. The not-at-risk group performed better on the stimulus discrimination and the vocabulary test when they did not consume breakfast. Performance was unrelated to glucose levels.
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TEACHERS' PERCEPTION SURVEY STUDIES

Study	Subject & Grade/Age	What was tested	Method	Result
<i>Ragno et. el. 1994.</i>	100 schools operating SBP. Grade 1 to 3 teachers	Teachers' perceptions of a school breakfast program	190 teachers were randomly selected to receive a questionnaire. Teachers responded to questions regarding general perceptions of the program and student behaviour.	87% of teachers reported that the SBP had a positive influence on the school day. 91% reported being aware of student hunger prior to the SBP and 86% stated that the SBP alleviated that hunger. 77% of teachers reported no change in attendance rates. 74%, 72%, 68%, and 67% reported that the SBP enhanced student attentiveness, energy level, concentration, and motivation, respectively. 61% reported that there might have been children who were hungry that were not participating in the SBP.
<i>SWC, 1996</i>	Parents, teachers, and students from schools	Evaluation of Child Nutrition Program for increasing nutrition education, improving classroom behaviour and performance, and increasing socialization opportunities.	Responses to teacher, parent, and child surveys with questions related to the goals of the program were evaluated.	Both teachers and parents indicated improved behaviour including increased interest in school work, improved academic performance, and increased energy and alertness.

Appendix B

BREAKFAST HABITS QUESTIONNAIRE

Year/Grade: _____ Gender: (Male/Female) _____

Date of Birth: _____

Please circle the suitable answers. You may circle more than one response in any question where necessary.

1. How often do you skip your breakfast?

Almost Never Sometimes Often Almost Always

2. What do you usually eat for breakfast?

Cereal Toast Bread Biscuits

Other (Write whatever you eat) _____

Nothing

3. If you eat toast or bread, what do you put on it? (If you don't eat toast or bread, please go to Question 4)

Butter Cheese Jam Peanut Butter Egg

Honey Vegemite Other (Write whatever you put on) _____

Nothing

4. What drink do you usually have for breakfast?

Tea Coffee Milk Water Juice Milo

Other (Write whatever you drink) _____ Nothing

5. If you don't have breakfast at home, when do you eat your first food of the day?

On the way to school On arriving at school

During recess (If you circle this, please go to Question 9)

During lunch time (If you circle this, please go to Question 9)

6. What do you usually eat for breakfast if you eat on the way to school or on arriving at school?

Cereal Toast Bread Biscuits

Other (Write whatever you eat) _____ Nothing

7. If you eat toast or bread, what do you put on it if you eat on the way to school or on arriving at school? (If you don't eat toast or bread, please go to Question 8)
- Butter Cheese Jam Egg Honey Vegemite
 Peanut Butter Other (Write whatever you put on) _____
 Nothing
8. If you eat on the way to school or on arriving at school, what drink do you usually have for breakfast?
- Tea Coffee Milk Water Juice Milo
 Other (Write whatever you drink) _____ Nothing
9. How do you feel on days you have not had your breakfast? (If you almost always have breakfast, please go to Question 11)
- Sleepy Inactive Anxious Feel headache
 Dizzy Depressed Understand the lesson with difficulty
 Forget the lesson Feel as if ants are crawling under your skin.
 Feels nothing
10. Why do you skip your breakfast?
- | | |
|----------------------|-------------------------------------|
| Never skip breakfast | Get up late |
| Usually not hungry | Spend too much time on other things |
| Want to lose weight | I don't like the food |
| Have no time to eat | Did not like to eat in the morning |
| Dieting | Food not available |
11. Do you usually eat breakfast ...
- | | |
|-------------------------------|--------------------------------|
| On my own | With some of my family members |
| With all of my family members | With friends Don't eat |
12. What does your mother do?
- Home duties Employed outside home in the day time
 Employed outside home on night shift

Appendix C

CLASS TEACHER'S ASSESSMENT/OBSERVATION PROFORMA

Dear Class Teacher,

Please write the academic grades (A-F) in the class grades column and also rate the other traits on a scale from 1 to 3 (1=not observed, 2=observed sometimes, 3=observed often). Except for the class grades, the ratings should be based on the class situation of this morning. Please bear in mind that this form is basically meant to judge the academic performance and general behaviour of children. Please leave blank where not applicable.

Name	Date of Birth	Class Grades			Lazy	Sleepy	Depressed	Anxious	Lack of short term memory	Truancy Behaviour
		English	Math	Science						

Appendix D

April, 2000

Mr./Ms. _____
_____ School,

Subject: Research on Relationship Between Breakfast, Academic Performance and Vigilance in School aged Child.

Dear Mr./Ms. _____,

I am writing to request permission for your school to participate in a research project being undertaken by The Graduate School of Education, The University of Western Australia in conjunction with the Western Australian Primary Schools.

The present research will try to reveal the relationship between breakfast, academic performance and vigilance in school aged child. The benefits of the research will be significant for educators and parents as well as the policy makers in the Education Department.

If approved by you, the research will involve twenty students from each 5th, 6th and 7th grades from your school. In the first phase a questionnaire will be distributed among the students for data collection about the consumption of different types of breakfasts and their effects on the academic performance and vigilance in the students. Moreover a proforma with already printed names and dates of birth of the students will be provided to the class teachers who will rate the appropriate behaviour of conditions of the children that morning and their class grades/performance in it. In the second phase two groups each comprising twenty volunteers, ten male and ten female (one having breakfasted and the other with no breakfast that morning) will be given computer based vigilance tasks later.

The study will be conducted at your school. No information relating to individuals will be supplied to any authorities or anyone else. No names will be used in any reports written about the study.

Your cooperation will be solicited in this connection.

With regards,

Yours sincerely,

Dr. Stephen Houghton MAPsS, AFBPsS.
Associate Professor in Educational Psychology
Registered Psychologist

Abdullah Khan B.S.Ed., Dip. OMA
Research Student
University of Western Australia

Appendix E

April, 2000

Dear Parent/Guardian,

Subject: Research on Relationship Between Breakfast, Academic Performance and Vigilance in School aged Child.

I am writing to request permission for your child to participate in a research project being undertaken at _____ School by the Graduate School of Education, The University of Western Australia in conjunction with the Western Australian Primary Schools. I have obtained permission from your school principal to conduct this study.

The present research will try to reveal the relationship between breakfast, academic performance and vigilance in school aged. The benefits of the research will be significant for educators and parents as well as the policy makers in the Education Department.

The research will involve your child participating in completing a questionnaire and further inclusion in a computer based vigilance task, if you like. In the first phase a questionnaire will be distributed among the students for data collection about the consumption of different types of breakfasts and their effects of the academic performance and vigilance in the students. Moreover a proforma with already printed names and dates of birth of the students will be provided to the class teachers who will rate the appropriate behaviour conditions of the children in it that morning. In the second phase two groups each comprising twenty volunteers, ten male and ten female (one having breakfasted and the other with no breakfast that morning) will be given computer based vigilance tasks later.

The study will be conducted at your school. No information relating to individuals will be supplied to any authorities or anyone else. No names will be used in any reports written about the study.

Your cooperation will be solicited in this connection.

With regards,

Yours sincerely,

Dr. Stephen Houghton MAPsS, AFBPsS.
Associate Professor in Educational Psychology
Registered Psychologist

Abdullah Khan B.S.Ed., Dip. OMA
Research Student
University of Western Australia

Appendix F

PERMISSION TO PARTICIPATE IN A RESEARCH PROJECT

I give permission for my child to participate in the research project conducted by Dr. Stephen Houghton and Abdullah Khan.

I have read the letter explaining the purpose of the project and I understand that my child's participation may involve completing a questionnaire and a computer based vigilance task.

I understand that I am free to decline that my child is free to decline to participate. Furthermore, my child may withdraw from the study at any time without prejudice.

I understand that I can call Dr. Houghton on 9380 2391 and request additional information about the study.

I understand that no names will be used in any results or publications arising from the study, and that all information collected will be treated in strict confidence.

I give permission to Dr. Houghton and Abdullah Khan to use and publish the information and conclusions generated from this study if they feel the field of education would benefit from the results.

..... (PARENT/GUARDIAN) DATE:

Appendix G

Univariate Analysis of Variance (Breakfast group Scheffe test)

Concentration Task

Tests of Between-Subjects Effects

Dependent Variable: Concentration Task

Source	df	Mean Square	F	Sig.
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YEAR	2	30.838	4.988	.014
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a R Squared = .263 (Adjusted R Squared = .210)

Post Hoc Tests

YEAR

Multiple Comparisons

Dependent Variable: Concentration Task

Scheffe

(I) YEAR	(J) YEAR	Mean Difference (I-J)	Sig.
5	6	-3.58(*)	.014
	7	-2.23	.175
6	5	3.58(*)	.014
	7	1.36	.437
7	5	2.23	.175
	6	-1.36	.437

Based on observed means.

- The mean difference is significant at the .05 level.

Homogeneous Subsets

Concentration Task

Scheffe

YEAR	N	Subset	
		1	2
5	8	8.50	
7	11	10.73	10.73
6	12		12.08
Sig.		.153	.484

(Non-Breakfast group Scheffe test)

Tests of Between-Subjects Effects

Dependent Variable: Concentration Task

Source	df	Mean Square	F	Sig.
YEAR	2	19.970	1.671	.202

a R Squared = .081 (Adjusted R Squared = .032)

Post Hoc Tests

YEAR

Multiple Comparisons

Dependent Variable: Concentration Task
Scheffe

(I) YEAR	(J) YEAR	Mean Difference (I-J)	Sig.
5	6	1.51	.546
	7	2.23	.222
6	5	-1.51	.546
	7	.72	.886
7	5	-2.23	.222
	6	-.72	.886

Based on observed means.

Homogeneous Subsets

Concentration Task

Scheffe

YEAR	N	Subset
		1
7	13	7.38
6	10	8.10
5	18	9.61
Sig.		.274

(Breakfast group Scheffe test)
Tests of Between-Subjects Effects

Sleepiness

Dependent Variable: Sleepiness

Source	df	Mean Square	F	Sig.
SCH	1	.157	2.651	.114

a R Squared = .084 (Adjusted R Squared = .052)

(Non-Breakfast group Scheffe test)

Tests of Between-Subjects Effects

Dependent Variable: Sleepiness

Source	df	Mean Square	F	Sig.
SCH	1	1.933	7.141	.011

a R Squared = .155 (Adjusted R Squared = .133)

Appendix H

ANOVA Results for Interactions

ANOVA was performed separately on each variable. The following table shows the results of the tests for interactions, F value, degrees of freedom and the significance of each behaviour (based on the teachers' observation on the testing day), vigilance (performance on tasks performed on the testing day) and academic performance in three learning areas (based on the children's Semester 1 and part of Semester 2 assessments).

ANOVA results for Interactions

	<u>B x Y</u>			<u>B x S</u>			<u>B x Y x S</u>		
	F	df	P	F	df	P	F	df	P
Vigilance									
Concentration	5.9	2	.005	0.6	1	NS	1.3	2	NS
Alertness (Accuracy)	1.4	2	NS	0.1	1	NS	0.2	2	NS
Alertness (Timing)	0.9	2	NS	0.1	1	NS	0.7	2	NS
Short-Term Memory	0.1	2	NS	0.3	1	NS	0.3	2	NS
Behaviour									
Laziness	0.8	2	NS	2.9	2	NS	1.7	2	NS
Sleepiness	0.0	2	NS	6.7	1	.01	0.4	2	NS
Depression	0.8	2	NS	0.0	1	NS	1.4	2	NS
Anxiousness	0.7	2	NS	0.1	1	NS	0.7	2	NS
Short-Term Memory	1.2	2	NS	1.2	1	NS	0.3	2	NS
Academic Performance									
English	0.0	2	NS	0.6	1	NS	0.6	2	NS
Maths	1.3	2	NS	1.9	1	NS	2.8	2	NS
Science	0.6	2	NS	4.5	1	0.4	1.2	2	NS

Error = 60, (B=Breakfast, Y=Year, S=School)

Note. The results for Truancy Behaviour were removed as inspection of the scores followed by testing of homogeneity of variance showed that the variable violated the assumptions (for cells separated by school and year), and small uneven cell sizes exacerbate the violation.

Appendix I

QUALITY OF BREAKFAST

The food were categorized into two groups; one having proteins while the other having carbohydrates. The breakfast having none or negligible amount of either proteins or carbohydrates was considered less nutritious while the breakfast with any proportion of proteins and carbohydrates was considered nutritious.

PROTEIN FOODS: Egg, Peanut Butter, Vegemite, Milk, Milo, Cheese etc.

CARBOHYDRATE FOODS: Toast, Cereals, Bread, Juices etc.

In order to classify high protein and carbohydrate foods, the following information (taken from food labels available in local supermarket) was used.

FOODS	Average Quantity of Proteins in 100g/ml	Average Quantity of Carbohydrates in 100 mg/ml
Egg (average serving size 100g)	13.6g	
Peanut Butter (average serving size 20g)	23.1g	17.6g
Vegemite (average serving size 5g)	25.6	19.5g
Milk (average serving size 250ml)	3.2g	4.9g
Milo (average serving size 200ml)	4.0g	10.9g
Cheese (average serving size 21g)	17.4g	4.8g
Toast (average serving size 59g)	8.0	45.1g
Cereals (average serving size 30g)	12.4	67.0g
Bread (average serving size 59g)	8.0	45.1g
Juices (average serving size 200ml)	less than a g	11.0g

	<u>Morning Breakfast</u>	<u>Breakfast on the way to school</u>
High in Protein	10	zero
Low in Protein	31	2
Very Low (or none) in Protein	31	38
High in Carbohydrate	13	3
Low in Carbohydrate	55	15
Very Low (or none) in Carbohydrate	10	22

Overall Summary of Quality of Breakfast

	<u>Morning Breakfast</u>	<u>On the way to school</u>
Nutritious Breakfast (High Carb. & High Prot.)	Zero	Zero
(Low Carb. & Low Prot.)	22	1
(High Carb. & Low Prot.)	5	Zero
(Low Carb. & High Prot.)	10	Zero
Total	37	1
Less nutritious Breakfast (High Carb. & No Prot.)	8	3
(No Carb. & High Prot.)	Zero	Zero
(No Carb. & Low Prot.)	4	1
(Low Carb. & No Prot.)	23	14
(No Carb. & No Prot.)	Zero	21
Total	35	39

Summary of Quality of Breakfast (Breakfast Group only)

		<u>Morning Breakfast</u>
Nutritious Breakfast	(High Carb. & High Prot.)	Zero
	(Low Carb. & Low Prot.)	8
	(High Carb. & Low Prot.)	2
	(Low Carb. & High Prot.)	4
Total		14/31 (45%)
Less nutritious Breakfast (High Carb. & No Prot.)	(No Carb. & High Prot.)	Zero
	(No Carb. & Low Prot.)	2
	(Low Carb. & No Prot.)	10
	(No Carb. & No Prot.)	Zero
	Total	17/31 (55%)

Overall Breakfast Quality Status

Non-Breakfast group		Breakfast group	
Less nutritious	Nutritious	Less nutritious	Nutritious
18	23 (not-at-risk)	17	14