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Breakfast and dietary balance: the enKid Study

Breakfast and performance

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Abstract

Evidence suggests that the effect of fasting on performance is not uniform, but it is dependent on the basal nutritional status of the subject. Breakfast consumption has a short-term effect in improving selected learning skills, especially work memory. School breakfast programmes have a positive effect on the nutritional status of children, on school attendance and probably on dropout rates. The effect of breakfast consumption on school performance depends on the interaction between the programme, student characteristics (malnutrition) and school organisation. Unless the school setting guarantees a minimum quality standard, the benefits of breakfast consumption will not be evident in performance in complex areas like language or maths.

Keywords
Breakfast
Children
School performance
Learning skills
Malnutrition
Growth

This review article summarises information from empirical sources about the effect of breakfast consumption on energy availability, nutritional status, school attendance and performance. The theoretical framework (Fig. 1) has been adapted from Pollitt and Matthews[1].

Effect of breakfast consumption on energy availability and brain function

According to popular tradition, a person having no breakfast (fasting) will not have enough energy to start morning tasks. This assertion has been tested in a series of experimental studies with the subject himself as a control.

The studies carried out by Pollitt and colleagues[2,3] on 9–11-year-old middle-class American children showed that fasting had a negative effect on visual perception and work memory capacity. Similar results were observed in studies carried out in other developed countries[4].

However, researchers in Jamaica[5] and Peru[6] found that the effect of fasting is not uniform, but depends on the basal nutritional status of the subject. The study in Jamaica followed the design used by Pollitt *et al.*[2,3] and compared three groups of children: (1) children whose height-for-age was two standard deviations below (−2SD) the reference group of the National Center for Health Statistics (NCHS); (2) children whose height-for-age was above −1SD from the reference group (NCHS) (control group); and (3) children with a clear history of early severe malnutrition according to the local register of the Nutritional Care Unit. Groups 1 and 3 showed similar results and thus were merged into a single group called 'nutritional risk group'. The nutritional risk group had poorer scores for language coding and fluency when fasting. The control group had similar results when fasting for these capacities; conversely they improved their scores for arithmetic tasks when fasting.

The results of a study in Huaraz, Peru[6], using the same design, were similar to those observed in Jamaica[5]. Negative effects were observed only in children in the nutritional risk group. Children at nutritional risk took longer to process information in a computerised memory test and in a computerised stimuli discrimination test. Fasting had no effect on performance in the control group but they took less time in the stimuli discrimination test and in a vocabulary test when fasting.

Pollitt and other researchers[1] found a negative effect of fasting in well-nourished children in developed countries, while this is not observed in malnourished children in developing countries. There is no clear interpretation for these results. Pollitt *et al.*[7] suggested one reason could be that children in developed countries usually have breakfast and thus not having breakfast becomes an unusual sudden event, while children from developing countries are not used to having breakfast and therefore they have developed an adaptation mechanism and have energy resources to be used rapidly when required. This is only a hypothesis to explain this phenomenon, which should be tested further: which subject characteristics (especially nutritional facts) have a negative relation with fasting?

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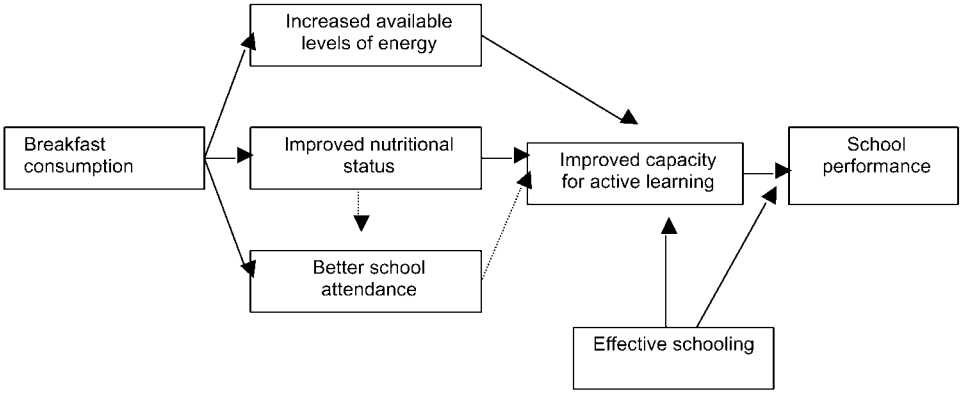

Fig. 1 Theoretical model for the relationship between breakfast and school performance

Effects of breakfast on nutritional status

Studies on short-term effects of breakfast on cognitive performance have often focused on an energy-dense breakfast with the aim of eliminating hunger. It has been hypothesised that an increase in glucose levels could have an effect on short-term memory[8].

Conversely, most school breakfast programmes have been designed to improve nutritional status in the long term and provide fortified foods for breakfast. This kind of breakfast provides between 1/10 and 1/3 of daily nutritional requirements (RDA) for the target population, depending on the nutrient and the programme. For certain nutrients like iron, 100% RDA is supplied[9]. It is expected that the daily supply of nutrients with breakfast will produce a benefit in the long term on nutritional status and well-being, and thus have a positive impact on cognitive functions and learning performance. Results of a study in Peru[10] showed that children in the school breakfast programme improved their average daily intake of energy, protein and iron by 15%, 16% and 60%, respectively. (School breakfast provided 100% RDA for iron.) Similar results have been reported in developing countries[11]. Finally, a study in Peru[12] found that average haemoglobin level in a group of children having school breakfast was 12 g dl^{-1}, while in the comparison group was 11 g dl^{-1}, controlling for socio-economic variables.

It is not clear whether breakfast has an impact on weight and height in primary school children. It has often been argued that, in order to produce such an effect, nutrition interventions should start at an early age. In fact, many of the above-mentioned studies on breakfast and performance in primary school children could not find any difference in this respect. However, Powell and colleagues[13] found significant differences in weight and height gain in second to fifth grade children having school breakfast after one year in the programme in rural Jamaica.

Effects of breakfast on school attendance

This effect is not directly related to nutritional consequences, but to economic benefits. Providing breakfast has an impact on nutritional status in the long term, it would also have a positive impact on morbidity, and thus on school attendance. Families would send their children to school as a means of saving money, having at the same time confidence in the quality of the food their children get at school. Many studies on school breakfast programmes both in developed and developing countries show a positive effect of the programmes on children's school attendance[10,13,14]. These effects appear at a relatively early stage after starting the programme and are maintained over time.

There is little evidence regarding school enrolment and school dropout rates, although a positive influence in both aspects might be plausible. A study in rural Peru analysed this fact in primary school children and concluded there was no positive effect on school enrolment, but it was favourable in terms of school dropout[12].

Effects of breakfast on school performance

It could be argued that any single benefit in the aspects discussed above could have a positive impact on children's school performance, but this hypothesis cannot always be confirmed. A series of studies found positive effects of school breakfast on school attendance, nutrient intake and cognitive skills but failed to find a positive impact on school performance. An explanation of this fact could be related to the school characteristics or to the school breakfast programme itself. In other words, it is not enough that students have a better nutritional status and they attend school, but it is also necessary that the school provides adequate stimuli to learn in order to get the benefit from this basal condition, and this is not always the case. Studies mentioned so far suggest that a

child who has school breakfast should be in a better condition to learn and perform. This is what some authors called the 'capacity for active learning' or 'educability'. Educability is defined as the ability of a child to adapt to school and fulfil the requirements of the school programme[9]. This concept implies physical aspects (health and nutrition), socio-emotional dimensions (motivation) and cognitive aspects. It is not enough that breakfast improves the child's educability; it is also required that the school capitalises on it.

There is some evidence that the school breakfast programme is effective only in well-organised schools[15]. Apparently all students having school breakfast are in a better condition to perform better at school, but whether this benefit can definitely be obtained depends on the school environment (well-illuminated, aired rooms; enough space; adequate teaching; etc.).

Conclusions and future perspectives

Based on available evidence, we can draw the following conclusions. (1) Breakfast consumption has a short-term effect in improving selected learning skills, especially work memory. This effect is more evident in children with previous malnutrition and may not be detected in other children. (2) School breakfast has a positive effect on the nutritional status of the children involved; this may show in weight and height gain in deprived populations (e.g. rural areas in developing countries). (3) School breakfast programmes have a positive effect on school attendance and probably on dropout rates. (4) The effect of breakfast consumption on school performance depends on the interaction between the programme, student characteristics (malnutrition) and school organisation. Unless the school setting guarantees a minimum quality standard, the benefits of breakfast consumption will not be evident in performance in complex areas like language or maths.

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