

AFFECTIVE AND NEUROPSYCHOLOGICAL COGNITIVE DYSFUNCTIONS OF THE GIARDIASIS INFECTION AMONG ORPHANAGE CHILDREN IN SHARKIA GOVERNORATE

By

MAHA S. BADAWEY^{1*}, AND NAGY M. FAWZY²

Departments of Parasitology¹ and Psychiatry², Faculty of Medicine, Zagazig
University, Sharkia Governorate, Egypt

(*Correspondence: mahasaber2007@yahoo.com)

Abstract

This study determined the affective disorders (anxiety & depression) and neuro-psychological cognitive dysfunctions of *Giardia* infection among orphanage children.

The sample included 294 infected children and 200 uninfected children recruited from four orphanages in Sharkia District, Egypt. Children between 5-12 years old, both sexes without social limitation were subjected to the study. Morning stool samples were collected in labeled cartoon boxes and examined for intestinal parasites mainly *Giardia lamblia*. Also, all children were subjected to the cognitive dysfunction determination by using the Wisconsin card sorting test (WCST), detection of affective disorders by Hospital Anxiety and Depression Scale (HADS). The results showed lower performance in *Giardia* infected group than the giardiasis-free ones regarding neuropsychological tests. The infected children showed lower performance than uninfected ones on Trial A and Trail B, but higher anxiety and depression score than uninfected children.

Key words: Egypt, Orphanage children, Giardiasis, Neuro-psychological disorders.

Introduction

Diarrhea in children causes malnutrition which increase morbidity and mortality in the developing countries, and affect the cognitive development (Grantham-McGregor, 1995). Early childhood diarrhea, defined as attacks of diarrhea in the 1st two years age, and negatively related with tests of cognitive function, verbal fluency and physical fitness growth faltering (Lorntz *et al*, 2006).

The hierarchical maturation of neocortical association areas, myelination, neuronal arborisation, emergence of brain networks and the interaction with environment are factors affecting early cognition development (Olness, 2003). Nutrition and infection have effect on neuroplasticity and development of children. Many hazards of brain developments like head injury, Iodine and iron deficiencies cause decrease in cognitive development (Guerrant *et al*, 1999).

The relation between diarrhea, malnutrition, education, social and economic status was difficult to determine the cause of cognition dysfunction. Childhood diarrhea disturbed visual-motor function, auditory short-term memory information processing func-

tioning, and cortical cognitive function (Aj-jampur *et al*, 2011). Association between parasitosis and impaired cognitive function and educational level was reported (McGarvey and Nokes, 1999). Chronic schistosomiasis *japonicum* was associated with poor short-term memory and slow reactions in children whom were improvement in cognition after treatment (Jukes *et al*, 2002). *Trichuris trichura* and ascariasis (Nokes *et al*, 1991) and malaria infection (Al Serouri *et al*, 2000) caused impaired cognitive function and decrease in educational achievement. Treatment of these nematodes increased height and muscular growth, improved heart rate recovery and increased the appetites (Stephenson *et al*, 1993). *Giardia* spp. affected about 20% to 30% of population, with reports of 100% in some areas; while 3% to 7% in developed countries (Jensen *et al*, 2009). *Giardia* and *Cryptosporidium* correlated with stunting, lower cognitive function scores, psycho-motor development defect and poor language cognition (Berkman *et al*, 2002). This was confined to either by giardiasis itself (Quihui-Cota *et al*, 2010) or by micronutrient deficiencies of zinc, iron and/

or A & B12 vitamins deficiency (Abou-Shady *et al*, 2011). Besides, about 1/3 of the giardiasis patients suffered from iridocyclitis, retinal hemorrhages and choroiditis (Barraquer, 1938), hypokalemia induced myopathy (Genove-se *et al*, 1996), long-term extra-intestinal manifestations (Cantey *et al*, 2011) and loss of epithelial surface of intestine and subsequent mal-digestion, mal-absorption followed by growth retardation (Halliez *et al*, 2013), as well as fatigue (41%) in outbreak in Norway (Hanevik *et al*, 2012)

On the other hand, the Egyptian Orphans shelter whether governmental or private is to live in a place where adaption and health advancement and social care, and institutional care is often followed continuously by the problematic psychosocial functioning of children (Al Ali 2000).

The present study aimed to evaluate the relation between giardiasis and neuropsychological cognitive dysfunctions among children in four Orphans in Sharkia Governorate.

Subjects and Methods

The study was done in the period from 1-6-2016 to 1-4- 2017, samples were recruited from 600 males and females. Children aged between 5-12 years old of both sexes all social and educational classes and all children lose one or both parents, the exclusive criteria were mental retardation syndromes, history of general physical diseases or psychiatric disorder.

Ethical aspect: A formed written consent was performed from the Ministry of Social Welfare Authorities in Sharkia Governorate and other written consent was attended from the caregivers or legal relatives of orphanages children, also oral awareness about the study to participant.

Data collection: The sociodemographic data, clinical and familial information were collected by the child follow-up sheet introduced to participants and their caregivers.

Parasitological examination: Three fecal samples were collected in clean wide labeled containers and examined immediately with wet mount smear and formol-ether sedimentation methods (O'Handley *et al*, 2000). Smears were stained in hematoxylin and eosin, Lugol's iodine solution (Xiao *et al*, 2014) as well as in modified Ziehl-Neelsen (ZN) staining to detect coccidian (Cheesbrough, 2004). Stools were examined macroscopically for consistency and mature or parts of worms. Stained smears were examined for worm eggs and protozoa. Duration and number of vomiting attacks per 24 hours (if present), fever during episode and/or dehydration level were recorded (Morris *et al*, 1994).

Wisconsin card sorting test (WCST) for determination of neuropsychological cognitive function (Schmittmann *et al*, 2006), which assessed the ability to abstract reasoning and to shift cognitive strategies due to environmental contingencies changing (Reitan, 1958). The WCST1 describe the total number of category completed by the subject within the 128 cards matched, while WCST2 described the subjective total perseveration errors done during matching the 128 cards (Heaton *et al*, 1993).

Hospital Anxiety and Depression Scale (HADS) was carried out to detect the anxiety and depression among the studied patients

Statistical analysis: Data were documented as numbers and percentages for qualitative socio-demographic variables, other correlation done by Statistical Package for the Social Sciences (SPSS) version 19.0 of the studied groups. The level of significance selected was P value < 0.05 and <0.001 statistically highly significant.

Results

Children with parasites other than giardiasis were excluded. The encountered cases were 294 giardiasis (patients) and 200 (control).

Details were given in tables (1, 2, 3 & 4).

Table 1: Sociodemographic data of infected and uninfected group

Variable	Giardiasis children 294		Control children 200	
	No.	%	No.	%
Male	226	77	118	59
Female	68	23	82	41
Residence Rural	89	30	69	35
Urban	205	70	131	65
Education: Received	221	75	121	60
Ignorant	73	25	79	40
Lost one parent	50	16.5	67	33
Both	244	83.5	133	67
Family communication +ve	163	56	111	55
Negative	131	44	89	45
	Mean	±SD	Mean	±SD
Age at admission (yrs.)	1.8 ±2.47		1.7 ±2.54	
Orphanage residence (yrs.)	6.6 ±4.62		6.2 ±3.76	

Table 2: Comparison between infected and uninfected children as regard to executive functions

Variable	Giardiasis children		Control children		T	P
	Mean	± SD	Mean	± SD		
Trail A	44.53	15.42	39.17	16.64	3.672	0.000
Trail B	140.41	48.76	90.94	37.47	12.118	0.001
WCST 1	4.81	2.24	6.94	2.90	9.193	0.000
WCST 2	20.90	7.97	10.92	5.38	15.47	0.000

Table 3: Comparison between infected and uninfected children as regard to memory

Variable	Giardiasis children		Control children		T	P
	Mean	± SD	Mean	± SD		
Information	5.10	1.19	5.21	1.21	1.001	0.317
Orientation	3.6	0.71	3.5	0.5	1.722	0.086
Mental Control	5.900	0.576	5.84	0.450	1.238	0.216
Logic memory	7.985	2.632	12.610	0.651	24.342	0.000
Digit span forward	7.06	1.12	7.33	1.778	2.008	0.045
Digit span backward	4.889	0.993	5.12	1.02	2.5102	0.012
Associative learning	18.38	1.73	24.40	1.85	36.908	0.000
Total memory	73.242	7.415	76.875	4.749	6.126	0.000

Table 4: comparison between hospital anxiety and depression scale (HADS) score among groups

Parameter	Giardiasis children	Control children	P
HADS	9.3±2.5	7.4±1.9	0.001

Discussion

Generally speaking, *Giardia lamblia* (syn. *G. duodenalis* and *G. intestinalis*) is one of the most frequent enteroparasites worldwide and has been included in the WHO as neglected disease initiative particularly among children (Savioli *et al*, 2006). *G. lamblia* infection can occur through ingestion of dormant cysts in contaminated water or food, or by the fecal–oral route (through poor hygiene practices). The cyst can survive for weeks to months in cold water (Huang and White, 2006). So, it can be present in the contaminated wells and water systems, especially stagnant water sources, such as naturally occurring ponds, storm water

storage systems and clean-looking mountain streams in rural areas (Daniels *et al*, 2015) and even in commercial fresh juices in urban areas (Mossallam, 2010). Besides, *Giardia* relies on glucose as its major energy source and breaks glucose down into ethanol, acetate and carbon dioxide. However, it can also use arginine as an energy source (Brown *et al*, 1998)

In Egypt, giardiasis is a wide-spread intestinal disease of both humans and animals; without any morphological distinction between different assemblages and/or genotypes (Amer, 2013). Morsy *et al*. (1991) in Qalyobia Governorate reported that ecto and endoparasites were still one of the pub-

lic health problems among primary school students. They added that these children were exposed to the intestinal parasitic infections (amoebiasis, ascariasis, enterobiasis, giardiasis, hymenolepiasis, taeniasis and schistosomiasis) or infestations (pediculosis and scabiasis). Makhlouf *et al.* (1994) in Cairo among children living in two orphanages; Ain-Shams and El-Mowassa reported amoebiasis, cryptosporidiosis, enterobiasis, giardiasis, hymenolepiasis). They reported that children in institutions as orphanages were more exposed to intestinal parasites, since crowding and behavioral pattern contribute greatly to the spread of infections. Morsy *et al.* (2000) an orphanage children in Nasr City reported pediculosis (59%) and scabies (26.9%), transmitted by contagious, especially among children in crowded areas. Mahmud *et al.* (2001) in Bilbeis reported *G. lamblia* infection in lactating children, as asymptomatic infections as long as four months, with a mean duration of excretion of 7.18 weeks. They added that breast-fed infants had fewer clinical manifestations, including mucus in stool, loss of appetite, and abdominal tenderness compared with infants who were not exclusively breast-fed. They concluded that breast-feeding must be considered as an effective means to prevent giardiasis and should be encouraged in highly endemic regions.

Eldash *et al.* (2013) in Al-Fayoum University's hospitals stated that recurrent abdominal pain (RAP) affected 10-20% of school-aged children. *Helicobacter pylori* and *Giardia intestinalis* were among organic causes of RAP, with different prevalence particularly in the developing countries as the common association diseases causing agents. They evaluated the incidence of *H. pylori* and *G. intestinalis* co-infection in RAP Egyptian among 90 children and 90 cross matched healthy controls. Giardiasis was found in 47 (52.2%) patients and 30 (33.3%) controls with a significant difference.

Helmy *et al.* (2014) in Ismailia G. reported

that the prevalence of giardiasis was 53% in ruminants & 21% in symptomatic children without positively correlated with diarrheal symptoms, as typing analysis proved predominance of B-type sequences (>67%) in humans, and E-type sequences (>81%) in ruminants over A-type sequences. They concluded that the risk of zoonotic giardiasis infection emanated from ruminants even in high prevalence areas was negligible. Genetic characterization indicated a predominant anthropogenic infection cycle within the pediatric population studied. Integration of sequence typing data with information on geographic origins of samples allowed parasite sub-population tracing using current typing tools. Fahmy *et al.* (2015) in Cairo stated that the genetic of giardiasis studies proved that at least eight assemblages (A-H) exist. Only, A & B were found primarily in man and occasionally in animals. The association between clinical symptoms and giardiasis assemblages was controversial. They concluded that giardiasis infection with assemblage B was more common than that with assemblage A. No associations between epidemiological information and assemblage were detected, except with age. Although infections with assemblage B were more frequently associated with abdominal pain and acute diarrhea than with assemblage A, the difference was not statistically significant. Genotyping of *G. duodenalis* isolated from various hosts has shown that assemblages A and B infect the largest range of host species, and appear to be the main (or possibly only) *G. duodenalis* assemblages that undeniably infect human subjects (Heyworth, 2016)

On the other hand, the persistent diarrhea was followed by decreased nutritional status, but early childhood diarrhea and nutritional level were independently correlated with impaired cognitive function (Kaur *et al.*, 2002). There were a high number of mental health problems, predominantly those of emotional nature. The early childhood malnutrition like micronutrient deficiency (Ka-

pil and Bhavna 2002), anemia and helminthiasis (Seshadri and Gopaldas 1989) were reported to affect cognitive development. In other countries as Brazil (Patrick *et al.*, 2005), Malaysia, (Al-Mekhlafi *et al.*, 2005), Turkey (Celiksoz *et al.*, 2005) and Bangladesh (Tarleton *et al.*, 2006) reported that early childhood diarrhea usually caused by enteric protozoan. Also, the malaria infection (Berkman *et al.*, 2002), *Entamoeba histolytica* (Tarleton *et al.*, 2006) and giardiasis caused adverse effects on the academic achievement, cognitive function and physical fitness. (Celiksoz *et al.*, 2005).

Hürlimann *et al.* (2014) studied the effect of deworming against soil-transmitted helminthiasis on children's physical fitness, cognition and clinical parameters in a malaria-helminth co-endemic setting of Côte d'Ivoire. They found that treatment had no effect on haemoglobin levels and anemia, but children with moderate- to heavy-intensity parasitic infection at the baseline gained weight more pronouncedly than non-infected children. They speculated that potential beneficial effects of deworming were likely to be undermined in areas where malaria was co-endemic and nutritional deficiencies were widespread.

The present study showed marked impairment in the neuropsychological cognitive function in giardiasis patients in which the cognitive domains showed lower performance than controls on Trail A and Trail B, as well as WCST with high significant difference as to their functions and attention,

In the pilot study, children showed a prolonged impact of early childhood diarrhea on the visual-motor coordination, auditory short-term memory information processing, and cortical cognitive function. Conversely, the forward digit span correlated with activity scores, and prospective problem solved in correlated with nutritional status, but not with diarrhea rates (Guerrant *et al.*, 1999). Also, Partovi *et al.* (2007) who detected that giardiasis children were affected cognitive functions compared to controls regarding

affected short term memory and long-term memory while that of arithmetic and coding test showed no significant difference between them. Weissman *et al.* (1999) showed that cognitive abnormalities were mild, transitory Zubieta *et al.* (2001) reported that infected children group had confirmed existence of cognitive deficits. This difference might in the small size, which did not demonstrate a significant relation between early childhood diarrhea and poorer fitness and cognitive function.

The present study showed greater impairment in verbal memory among patients with giardiasis. Conversely, Feldman (2009) did not find a statistical difference in logical memory between euthymic giardiasis patients and healthy control, but; they found that performance on tests of associative learning was poorer in giardiasis patients relative to controls, which was in consistency with our study. While, decrease in cognitive domains especially verbal memory and some executive functions were documented in infected children (Quraishi and Frangou, 2002).

The present study showed marked memory deficit that differed from Potter *et al.* (2010) who studied school children, rather than orphanage cultures that affect cognition due to social isolation and learning disabilities. But, the present data agreed with Seshadri and Gopaldas (1989) and Lorntz *et al.* (2006).

In the present study, the prevalence rate of depression and anxiety in orphan patients was higher than controls. But, the total anxiety depression rates were somewhat lower than those in other countries. The sympathy, social support and the advices in holly Quran to look after the orphan child, helped to decrease psychiatric disorder and socio-culture burden among orphans (Fawzy and Fouad, 2010). The present results went with study performed on children admitted to orphanages in Gaza Strip where (39.3%) suffered from post-traumatic stress disorder were considered as an evidence of anxiety, Thus, orphaned children were affected by

both exposure to trauma and family loss due to occupation and/or wars. The low psychosocial support made them vulnerable to depression (Thabet *et al*, 2007). The present results agreed with Jorngarden *et al*. (2006) where the patients scored significantly worse than the controls for both anxiety and depression based on the HADS scores. Frequencies of depression and anxiety among patients according to this score did not represent primary form, but reflected comorbid illness secondary to long-standing chronic fatigue. Sharpe *et al*. (1992), Moss-Morris and Spence (2006) and Afari and Buchwald (2003) reported similar or higher HADS scores among patients with chronic fatigue, orphans and unsatisfied about their circumstances with emotional problems associated with high risk of adult mentality.

Conclusion

Orphan or institution children demonstrated high rates of psychiatric symptoms. Institutionalization duration, physical stature, and age at abandonment differentially relate to psychiatric symptoms. Findings are interpreted in light of implications for intervention and social policy.

The outcome results showed a high rate of cognitive dysfunctions and affective disorders strongly correlated with giardiasis prevalence among orphanages children. Undoubtedly, the schoolaged children are the group at risk group for ecto- and endo-parasites conveying these parasites, particularly those transmitted by contagious and autoinfection to other colleagues and their family members.

Recommendations

Critically, the governmental authorities must establish official system to address the orphan's problems in the community and enhancing social support services.

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