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Child health, parasites and lower socioeconomic status: Outcomes of a long-term screening, intervention and training study by health volunteers in rural Nepal.

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ABSTRACT

Background: Nepal is a developing country with limited resources for health provision due to its geographic difficulties and frequent natural disasters, such as floods and earthquakes. Children are at risk of growth retardation due to inadequate food intake and unhealthy environment. Lower back pain is common among the adults and causes limitations in daily activities.

Material/methods: A group of voluntary Turkish medical students, doctors and civil members conducted a field study, together with Nepalese doctors (MDs) and local volunteers, concerned with health-screening, intervention practices and on-site training in rural Nepal between 2013 and 2015. Physical examination of participants, together with stool examinations for parasites were done and those for whom treatment was indicated were referred to MDs who also ran a field pharmacy containing donated medications.

Results: Totally, 1148 individuals-725 children and 423 adults-were screened between 2013 and 2015. Musculoskeletal problems and upper respiratory tract infections were primary complaints among adults and sick children, respectively. Three-quarters of 203 collected stools had ≥ 1 parasite(s).

Conclusions: Growth retardation in children observed during the study, the burden of intestinal parasites on Nepalese children and unavailability of effective health services for citizens in rural areas should direct local authorities to allocate greater resources for country's health infrastructure improvement and to provide a higher standard of childhood nutrition.

1. Introduction

Unsatisfactory sanitation, an insufficient supply of potable water and nutritional deficiencies are the leading health factors that differentiate the developed and developing countries (Cronk et al., 2015). Nepal is one such developing country in Central Asia, located between China and India, with a population of 29 million, more than 80% of which live in rural areas (Fig. 1). It has an estimated gross domestic product (GDP) of 729 USD per capita in 2016 and low Human Development Index (HDI) of 0.558 according to United Nations, ranking as

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Fig. 1. Map of Nepal indicating our sites of research in 2013, 2014 and 2015.

144th in the list of 187 countries in 2016. The birth rate is around 22% and the average life expectancy for its citizens is 66 years (WHO, 2012).

Geographically, Nepal is divided into three ecological zones, which differ extensively in terms of altitude, temperature, annual precipitation and predominant vegetation type. Kathmandu is the capital city, located 1300 m above the sea level and its population is around 1.5 million. Other cities include Biratnagar, Patan, Pokhara, Birganj, Dharan, Nepalganj, and their population is less than 0.2 million[1].

Due to its complicated geophysical structure, Nepal has been prone to natural disasters, such as earthquakes, infection outbreaks and floods during monsoon season (UNDP 2016; Gaire et al., 2016). A high-magnitude earthquake hit the country in 2015, leaving behind 9000 victims and more than 23,000 injuries. Such natural disasters cause high economic burden to Nepal, limiting its resources to supply even safe drinking water and food to its residents (Gaire et al., 2015). In such conditions, outbreak risks of infections such as cholera, Hepatitis E and certain bacterial and parasitic causes of diarrhoae are dramatically elevated, posing a dramatic risk for the survivors (Hendriksen et al., 2011; Shrestha et al., 2016; Simkhada et al., 2015).

Children are under the threat of malnutrition and stunting in Nepal, which was worsened and reached 37% in children under 5 years, after the earthquake in 2015 (Gaire et al., 2016; Tiwari et al., 2014). Stunting is a long-term process and is closely associated with malnutrition, inadequate infrastructure of the environment and high burden of infectious diseases (GBD, 2015; UNDP 2016; Gaire et al., 2016; Tiwari et al., 2014). Here, intestinal parasites, especially the helminths may play a major role. Intestinal parasites are prevalent in developing countries and are closely associated with poor hygiene, lower socioeconomic status and insufficient health services (UNDP 2016; Gaire et al., 2016; Tiwari et al., 2014; Kunwar et al., 2016; Östan et al., 2007). More than three billion people worldwide are at risk of intestinal parasitic infections, with 450 million people, mostly the school children, have actual infections (Tandukar et al., 2013, 2015; Dhital et al., 2016;). Currently, *Giardia lamblia* and *Entamoeba histolytica* are the leading protozoa, while *Trichuris trichiura*, hookworms and *Ascaris lumbricoides* are common intestinal helminths in Nepal (Dhital et al., 2016; Tandukar et al., 2013; Malla et al., 2004; Mukhopadhyay et al., 2007; Moffat 2003).

Despite governmental initiatives, Nepal still lacks a public health insurance scheme that covers all its citizens. The share of public health expenditures in the budget is around 3% in Nepal (UNDP 2016), while out-of-pocket payments constitute almost 90% of private, and 55% of total health expenditures (Gupta and Chowdhury 2014). Public healthcare services in Nepal are delivered through Health Centers (HCs), Primary Health Care Centers (PHCs), Health Posts (HPs), Sub-Health Posts (SHPs) and clinics. Zonal and District Hospitals constitute the secondary level whereas Central and Regional Hospitals function as the tertiary level. There are also private healthcare institutions, Medical College Teaching Hospitals and Nursing Homes (Gupta and Chowdhury 2014; Rai et al., 2001; Witter et al., 2011). However, Nepalese citizens who live in rural areas hardly access adequate health services due to challenging geographical conditions and insufficient hospitals and healthcare staff (Mishra et al., 2015). The public health system is partly supported by international organizations, such as World Health Organization, and non-governmental organizations (NGOs) from different countries that provide voluntary services countrywide (Rai et al., 2001).

In this article, the outcomes of an intervention by volunteer students from Acibadem Mehmet Ali Aydinlar University (ACU) in Istanbul, together with a Turkish NGO, The Medical Rescue Association (MEDAK), involved in the provision of health services and the training of local people for the three consecutive years 2013–2015, are presented.

2. Materials and methods

2.1. Study team

Volunteer students from ACU and colleagues from MEDAK visited different regions of Nepal for periods of two weeks between 2013 and 2015, consecutively, during summer and undertook a particular task entitled the “Nepal Social Paediatrics Project” (NSPP). The university students were from the faculties of Medicine, Physical Rehabilitation and Nursing, while the participants from the NGO were experienced field workers who had previously participated in similar activities in different regions of the world. Both students and NGO members had collaborated on health-related voluntary activities previously, both within Turkey and abroad. Each year, at least three volunteer Turkish

[1] http://worldpopulationreview.com/countries/nepal-population/ (Access Date: 26th April 2019).

doctors working in different departments at ACU and Acibadem Health Group participated in the NSPP. During the field studies, the group members were accompanied by voluntary junior Nepalese doctors and the members of a local professional guidance group that established communication with residents and arranged transport, the delivery of food and water, and accommodation for the volunteers.

2.2. Study site

The study was conducted in three provinces of Nepal-Bandipur, Nagarkort and Kathmandu-between 2013 and 2015, respectively (Fig. 1). Nagarkot is 32 km away on the east of Kathmandu and located 2175 m above sea level. Banipur is 143 km on the west of Kathmandu and 1030 m above sea level. The rural areas within these provinces were chosen for the intervention, in consultation with the local authorities and the Nepalese volunteer doctors who took part in the study.

2.3. The scope of the study

During their visits, the group organized health camps in primary schools, provided health screening for the residents and offered primary health care with medications on a no-cost basis to those needing treatment. Before these field studies in Nepal during summer, the NSPP volunteers received special training from the specialists in ACU, the NGOs and experienced volunteers from MEDAK.

2.4. Preparation of project documentation, ethical approval

Project documents were developed under the supervision of academic staff members of ACU. Ethical approval was obtained in Turkey from the Board of Ethics in Acibadem University. The project was also approved by the Village Development Committee, which is a part of the Kathmandu Metropolitan City in Nepal. Informed oral consent of the adults was obtained for the study with face-to-face interviews, while children were accompanied either by their parents and or teachers, Nepalese physicians and Nepalese interpreters during the receipt of their oral consents.

2.5. Health-care related activities conducted during the field study

The voluntary medical students made general physical examination to all participants of the study and recorded the data into the database. Then, measurements including the body weight, height, pulse, oxygen saturation, tympanic temperature of children and blood pressure of adults were conducted. Assessment of blood groups and glucose levels, together with urine dipstick test were done before the O/P examination of stools of the voluntary participants. The material and equipment used in the study had already been transported from Turkey. The physical examinations of the individuals as well as laboratory tests were conducted under the supervision of the Turkish or Nepalese medical specialists who attended the project. In 2015, physiotherapists were present in the study; they examined the adults for their musculoskeletal problems and trained them in making routine palliative exercises for the management of their lower back pains. They referred those that needed immediate medical treatment to voluntary doctors in the group, who treated them with anti-inflammatory drugs and/or muscle relaxants and referred them to local specialists for the follow-up.

2.6. Parasitological assessments

Volunteers delivered their stool samples in capped plastic containers upon request. They were immediately put in two different vials, one with a fixative solution (SAF - sodium acetate-acetic acid-formaldehyde) to maintain the morphological unity of the possible parasites and the other empty one destined for molecular assessments. They were transferred to the research laboratory of ACU for parasitological assessments, including microscopic examination of stool with saline and Lugol's solution, concentration, Kinyoun's staining for Coccidiae and PCR for *Dientamoeba fragilis,* as described previously (Verweij et al., 2007). In 2015, saline-Lugol examination was done on-site by the MD specialist in Medical Parasitology who came to the field site that year. Stool samples, received with and without the fixative were then transferred to ACU for again Kinyoun's staining for Coccidiae and PCR for *Dientamoeba fragilis,* as described previously (Verweij et al., 2007). Those who were found to be infected with parasites were then treated with suitable antimicrobials, such as metronidazole or albendazole; this was done by the Nepalese doctors just after the study in 2013 and 2014 when the parasitological assessments were done in Acibadem University laboratories in Istanbul, while it was done immediately in 2015 when on-site parasitological examination of stools was possible.

2.7. Training activities for local children and adults conducted during the field study

Following the completion of planned examinations, the Turkish volunteers provided teaching activities for primary school children including proper handwashing and brushing teeth, aimed at improving the children's health-related activities of daily living. In addition, MEDAK members organized two different training sessions for adults: First Aid and Appropriate Interventions After Natural Disasters. They were also given basic training in appropriate rescue interventions for individuals injured by the debris produced by an earthquake, as well as how to transport patients to hospital.

2.8. Collection of data and statistical analyses

A unique data collection form was prepared for the study. Study data were collected by hand-written hard copy in 2013 and 2014, but subsequently using database software, “FileMaker® Pro” in 2015, with an aim to reach more individuals after the earthquake in the region. Using this software, the researchers managed to record the patient data and their examination findings on the database simultaneously from different stations. All study data were then combined within an Excel® file and assessed for statistical analyses using SPSS®16.0, and p levels ≤ 0.05 are regarded as significant.

For growth percentiles, non-parametric Mann-Whitney U test was used to identify any statistical differences between two groups (the group without parasite and the group with at least one parasite). Since height of the children is affected in long-term, only the weight to age percentiles were used for the statistical analyses, which were done using STATA IC 15 version, and double-checked by an online calculator (https://www.socscistatistics.com/).

3. Results

The researchers managed to examine 711 individuals within two weeks in 2015, whereas the total number was 437 within a total of four weeks in 2013 and 2014. (Table 1). The chief complaint of children (aged below 18 years) was abdominal pain (21%), followed by cough (10%) and fever (5%) in 2013 and 2014. Mothers of 2% of the children had stated that they had been using medications prescribed by the local physician for the upper respiratory system infection of their children. Parents of 288 children (65.9%) reported that their children had received a complete set of childhood vaccinations, including DTP (diphtheria-tetanus-poliomyelitis),HiB (*Haemophilus influenzae*), Hepatitis B, Measles, Japan Encephalitis, OPV and BCG.

Musculoskeletal complaints and pain (mostly in the form of backpain) are the leading complaints as well as prior hospitalization causes of the people in the area (Tables 2 and 3). Blood pressure measurements of adults indicated that 50 (11.8%) adults had high blood pressures (> 140/90 mmHg); however, there had been no prior medical attention to blood pressure, nor the use of anti-hypertensives. In addition, almost

Table 1
Outline of field work and the numbers of individuals examined between 2013 and 2015.

		2013 and 2014 (n,%)*	2015 (n, %)*	Total
Total number of individuals examined		437 (100)	711 (100)	1148
Number of children (<18 years) (n,%)		437 (100)	288 (40.5)	725
Number of adults (> 18 years) (n,%)		0 (0)	423 (59.5)	423
Sex	**Male**	214 (49.0)	369 (51.9)	583
	Female	223 (51.0)	342 (48.1)	565
Mean age (Range)		9.4 (2 weeks – 18 years)	30.6 (2 months – 89 years)	
Age Groups	**0–5**	108 (24.7)	73 (10.3)	181
(Years)	**6–18**	329 (75.3)	215 (30.2)	544
	19–65	0 (0)	316 (44.4)	316
	> 65	0 (0)	107 (15.1)	107
	TOTAL	437 (100)	711 (100)	1148

* The percentages reflect the ratios of the columns.

Table 2
The causes of prior hospitalizations of adults in the study (n = 220).

The cause of previous hospitalization(s)	n	%
Musculoskeletal System Complaints	81	36.8
Surgical Operations and Check-ups	42	19.0
Hypertension and Cardiac Complaints	33	15.0
Pneumonia	30	13.6
Fever	24	10.9
Visual Acuity Problems	19	8.6
Hepatitis B	15	6.8
Urogenital Problems	15	6.8
Pregnancy	9	4.1

Table 3
Complaints stated by adults (n = 422) during physical examinations.

Complaints	n	%
Musculoskeletal problems	122	28.9
Pain of any site in the body	88	20.9
Sensation defects	54	12.8
Dermatological problems	50	11.8
Dysuria	12	2.9
Psychological problems	71	16.8
Others (breathing difficulty, etc.)	25	5.9

one-fifth of them (n = 72; 17.1%) reported sleep disorders and/or anxiety with an onset coinciding with the 2015 earthquake. Forty-one adults (9.8%) reported regular use of a medication prescribed by medical doctors. Proton-pump inhibitors (n = 15; 36.6%) and anti-asthmatic agents (n = 6; 14.6%) were the common prescriptions in this group. Almost half of the adults (n = 208; 49.3%) self-reported frequent consumption of alcohol and/or tobacco daily. Only 1 in 20 women gave birth in a hospital, and there were no caesarean sections.

Site visits were conducted to reach older, housebound, or otherwise immobile individuals. Observations of the in-house living conditions showed some potential hazards to human health, such as inadequate ventilation in kitchens where biomass fuels were predominantly used for cooking, and absence of an effective sewage system in toilets which were mostly located outside the house.

3.1. Review of the assessments of children

Among 278 children in the study (mean age: 8.6 years), males outnumbered females (158 [56.8%] vs. 120 [43.2%]), and children had on average two siblings. A total of 145 children (52.2%) had been hospitalized once previously, mostly due to pyrexia (n = 102; 36.8%). Complete vaccination was reported by 176 (63.3%) parents, while at least one vaccination was declared missing by the parents of the rest, with no further data. During the physical examinations, 158 (56.8%) children were found to be healthy, whilst Among those diseased, respiratory tract infections were found to be the most common problem.

3.2. Review of the parasitological assessments

All examined stool samples were of children in the study. Almost three quarters of the examined stool samples (150 of 203; 73.9%) had evidence of at least one intestinal parasite (Table 4). Diarrhoeic stools were uncommon (n = 25; 12.8%), and only 34 children (16.7%) reported symptoms such as abdominal pain, constipation/diarrhoea or loss of appetite, which are common in patients with intestinal parasitosis. The leading protozoal agents were *Blastocystis, Dientamoeba fragilis, Giardia intestinalis, Entamoeba histolytica/dispar* and *Cryptosporidium spp*. Helminths were relatively uncommon in our series; only *Hymenolepis nana, Trichuris trichiura, Strongyloides stercoralis*, hookworms and *Taenia saginata* were identified. Prescriptions of children who required anti-parasitic treatment were supplied by the physicians in the study.

There was a correlation between a positive stool result for parasites and being on a lower percentile for growth than that predicted by either WHO charts (WHO, 2006) that demonstrate the expected weight healthy boys and girls at different ages, or those normalised for the study population (p = 0.01). It is worthy of note that all the children studied (whether infected with parasites or not) were below the 50th percentile on the WHO charts (Fig. 2).

4. Discussion

The main aim of this study is to present the outcomes from a child-orientated health project conducted in different regions of Nepal for three consecutive years, between 2013 and 2015, and highlight the current public health risks and healthcare problems among Nepalese people, especially children living in rural regions. Our clinical observations at the time of the site visits, as well as the subsequent analysis of the outcomes indicate that growth retardation is a common problem among Nepalese children. Its effect on weight was more marked than on height in children, but both were abnormal in parasitic infections, indicative perhaps of a more chronic infective process with an attendant risk of growth retardation. This finding is corroborated by previous studies where the rate of stunting among children under 5 years in Nepal was reported as 37.4% (UNDP 2016;Tiwari et al., 2014). Although a prominent decrease in stunting by 16% in Nepalese children was reported between 2001 and 2011, our findings indicate that it is still a primary public health problem, at least in the rural areas of the country.

Houses in rural Nepal are mostly built in traditional mud brick style with no toilets or bathrooms inside; people use outside toilets or defaecate on the open ground, which poses a serious threat to people for infectious diseases. Previously, a large-scale outbreak of cholera has been documented in Nepal due to contamination of drinking water with human waste (Tamang et al., 2005). It was also shown that common exposure to *G. lamblia* and *E. histolytica* were associated with persistent diarrhoae in children below 5 years, which may lead to malnutrition and growth retardation (Malla et al., 2004; Mukhopadhyay et al., 2007; Moffat 2003; Uga et al., 2004). Lack of an infra-structure capable of maintaining a continuous supply of electricity and running water to houses in rural regions exacerbates the situation further, since food may be more readily contaminated, and potable water difficult to obtain.

The high parasitic load in Nepal has long been described in all age groups, especially before the 1990s when sanitation and hygiene were even less developed (Estevez et al., 1983). Studies have shown that *Entamoeba histolytica, Blastocystis* spp. and *Giardia lamblia* have been the principal parasites, while helminths such as *Ascaris lumbricoides* and *Trichuris trichiura* were present as well (Kunwar et al., 2016;

Table 4
The results of the parasitological examinations of stool samples of 203 children collected between 2013 and 2015 in the study.

		2013–2014[ζ] (n,%)	2015[ζ] (n,%)	TOTAL (n,%)
STOOL SAMPLES	Examined stool samples *	114 (56.2)	89 (43.8)	203 (100.0)
	No parasite (*Negative*)**	18 (15.8)	35 (39.3)	53 (26.1)
	One or more parasites **	96 (84.2)	54 (60.7)	150 (73.9)
	More than one parasite **	45 (39.5)	29 (31.5)	74 (36.5)
PROTOZOON	*Blastocystis* spp.	36 (31.6)	22 (24.7)	58 (28.6)
	Dientamoeba fragilis	42 (36.8)	10 (11.2)	52 (32.7) [ζ]
	Giardia lamblia	18 (15.8)	16 (18.0)	34 (16.7)
	Entamoeba histolytica/dispar	20 (17.6)	8 (9.0)	28 (13.8)
	Cryptosporidium spp.	17 (15.0)	7 (7.9)	24 (12.2)[ζ]
	Cyclospora cayetanensis	10 (8.8)	4 (4.5)	14 (7.1)[ζ]
	Entamoeba coli	4 (3.5)	1 (1.1)	5 (2.5)
	Chilomastix mesnili	0 (0)	3 (3.4)	3 (1.5)
	Iodamoeba bütschlii	1 (0.9)	2 (2.2)	3 (1.5)
	Endolimax nana	0 (0)	2 (2.2)	2 (0.9)
HELMINTH	*Hymenolepis nana*	0 (0)	3 (3.4)	3 (1.5)
	Trichuris trichiura	3 (2.6)	0 (0)	3 (1.5)
	Strongyloides stercoralis	0 (0)	2 (2.2)	2 (0.9)
	Hookworms	0 (0)	2 (2.2)	2 (0.9)
	Taenia spp.	1 (0.9)	0 (0)	1 (0.5)

[α] Parasitological examinations were done only in the Research Laboratories of Acibadem Mehmet Ali Aydinlar University in Istanbul, Turkey, using the transferred stool samples of children in SAF (Sodium acetate-acetic acid-formalin) fixative and in an empty vial for PCR.

[β] Parasitological examinations were done both on-site, in the mobile laboratory in the study area in Nepal by an expert parasitologist, and then in the Research Laboratories of Acibadem Mehmet Ali Aydinlar University in Istanbul, Turkey, using the transferred stool samples of children in SAF (Sodium acetate-acetic acid-formalin) fixative and in an empty vial for PCR.

[*] The percentage belongs to the figures in the lines.

[**] The percentage belongs to the figures in the columns.

[Ω] After the interpretation of the PCR assessments of 159 eligible stool samples.

[φ] After the examination of Kinyoun-stained smears of 197 eligible stool samples.

Dhital et al., 2016; Sharma et al., 2004; Sah et al., 2013; Lee et al., 2012; Macchioni et al., 2015). In a recent study conducted in Kathmandu, almost one-fifth (19.1%) of school children under 15 years old were found to be infected with parasites, where G. lamblia and Ascaris lumbricoides were the leading agents (Shrestha et al., 2019). In another study by the same authors in Dolakha and Ramechhap in Nepal, the prevalence of intestinal parasites reached 39.7%, with *Trichuris trichiura* (30.9%), *Giardia lamblia* (30.5%) and the hookworms (30.2%) as the leading parasites in children (Shrestha et al., 2018). To overcome such high parasitic load in children extensive nationwide measures have been applied since early 1990s, with an aim to improve the hygiene standards as well as the education and economic standards of the country. These measures were accompanied by nationwide campaigns in primary schools such as “deworming programs” that aim to lower the prevalence of intestinal parasites and serving lunchtime meals in schools and giving Vitamin A supplementation to school children (Pradhan et al., 2014; Khanal and Walgate 2002). This intensive work has achieved some partial success, but intestinal parasites are still prevalent among the children, especially in rural regions (Estevez et al., 1983; Pradhan et al., 2014; Khanal and Walgate 2002; Pombos et al., 2012). In our series, helminths were found relatively more uncommon than protozoa in Nepalese children. High levels of *D. fragilis* and Blastocystis were, on the other hand, not surprising when compared to similar studies employing molecular diagnostic methods (Röser et al., 2013; El Safadi et al., 2014).

Examination of Kinyoun-stained smears revealed that *Cryptosporidium* spp. and *Cyclospora cayetanensis* were present in 24 (12.2%) and 14 (7.1%), respectively. These are relative high figures, but also mostly within the range of the previous studies (Kunwar et al., 2016; Tandukar et al., 2013, 2015; Dhital et al., 2016; Malla et al., 2004; Mukhopadhyay et al., 2007; Uga et al., 2004; Pradhan et al., 2014; Sharma et al., 2004; Bhandari et al., 2015; Bhattachan et al., 2017). The timing of the study visits coincided with the monsoon, a period at which greater exposure to infectious diseases is the norm. Notwithstanding the controversy over the pathogenicity of *Blastocystis* and *D. fragilis* (Kurt et al., 2016; Holtman et al., 2017), it is noteworthy that the pathogenic protozoa such as *G. lamblia, E. histolytica/dispar* and *Cryptosporidium* spp. were identified, each with a prevalence of over 10%. Yet, intestinal helminths were rare in our series, which may be due to previous successful application of deworming programs on school children in Nepal. Regarding all these risks mentioned above, it is highly desirable that country-wide measures be taken to lower the rates of intestinal protozoa in Nepalese children.

As noted above, parasitic infections are correlated with slower growth rates in children. This is clearly outlined in the comparison of the weight and heights of the children with and without parasites in our study group. The effect on weight was more marked than on height, but both were abnormal in parasitic infection, indicative perhaps of a more chronic infective process with an attendant risk of growth restriction. Despite almost all children showed signs of malnutrition and failure to thrive, parasite-free children had higher results, in terms of growth chart percentiles, compared to infected children.

Rural regions of Nepal are home to 82% of the total population (UNDP 2016). Due to challenging geographic conditions and poor resources, a sanitary/sewerage system in these areas is almost completely absent and potable water is mostly not available (Rai et al., 2001). It has previously been reported that rural households are obliged to spend more on healthcare, compared to individuals residing in cities, as residents of rural areas need to walk for extensive amounts of time over unsafe roads, especially in monsoon season, to reach a health care provider (Gupta and Chowdhury 2014). Using vehicles may sometimes entail greater danger than walking due to the hazardous condition of roads following heavy rain. Perhaps unsurprisingly in the light of these considerations, the study involved some elderly participants from rural areas who reported having never received qualified medical aid before. Development and allocation of special funds for the implementation of more health offices closer to rural areas and recruitment of more medical staff, including physicians, nurses and midwives who will actively follow-up the patients, pregnant ladies, newborns and children will no doubt improve the life quality of citizens in rural regions.

During the site visits, it was observed that rural houses often had open kitchens located in part of the living room with an open pit/stove/

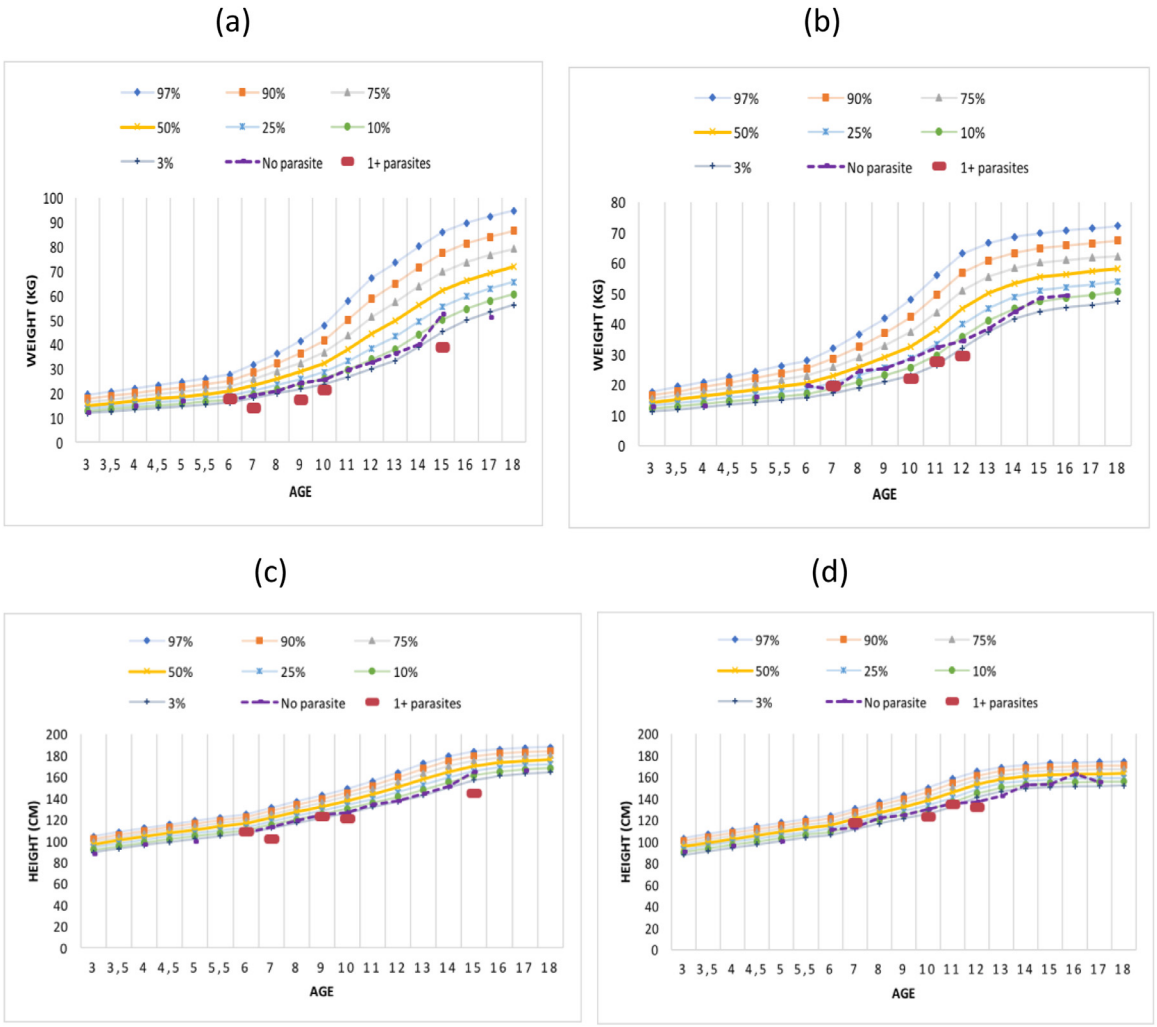

Fig. 2. The growth charts of boys (a and c) and girls (b and d) in the study infected with and without parasites.

fire that lacked a basic ventilation system to remove fumes. Biomass fuels, associated with increased risk of pulmonary diseases, were widely used in such houses which poses a grave threat, especially to women, who spend more time in their houses than men. Although respiratory system complaints do not feature greatly in our adult patient group in 2015, this potential threat should still be taken into consideration in setting a plan for developing standards in rural Nepal.

Musculoskeletal problems, such as low back pain, muscular spasms and hernia in advanced cases were also common among local women who habitually carry heavy loads on their backs for domestic needs in their daily life. Low back pain is one of the most common and critical under-prioritised non-communicable diseases is Nepal (Sharma et al., 2019). It is estimated that 60.1 million disability-adjusted life years were due to low back pain in the world in 2015, which shows a tremendous increase of 54% since 1990. It was elevated at a rate of 16.9% in Nepal since 2005. Physical inactivity due to low back pain may deepen the poverty of local people, especially in rural areas. The voluntary physiotherapists in our study team examined those adults during the study, supplied necessary medications with the doctors and taught them correct care techniques to prevent its negative consequences.

Most women in our study (81%) stated that they had given birth at home, only rarely under the supervision of a skilled birth attendant; this is discordant with the latest data which indicates that 41.9% of Nepalese women give birth at home (Dhakal et al., 2018). Choosing health institutes instead of houses for births was encouraged by Nepalese government in the late 1990s, which gave way to a dramatic increase in births in health institutes between 2006 (18%) and 2011 (35%). However, there are still many births in Nepal every day that take place inside houses, without any guidance of an experienced healthcare provider. It is also noted that the risk of stillbirths is more common for rural ladies and is closely associated with low socio-economic status (Jahn et al., 2000). The maternal mortality ratio is extremely high (5.39 per 1000 live births), while the mortality rate of children below 5 years is 40 per 1000 (UNDP 2016; WHO 2012).

One of the prominent aspects of this project is its training content to school children and adults. Living under the threat of natural disasters, it is suggested to provide “First Aid and Appropriate Interventions After Natural Disasters” training to Nepalese residents to increase preparedness, help them to organize faster and save more lives in such conditions (Peleg 2015; Hall et al., 2017). In addition, our training young school children for hygienic daily activities such as handwashing with soap during the study has also been suggested in similar studies in Nepal, to prevent any risk of transmission of the microbes to children (Shrestha et al., 2018).

Main limitations of our study include the geographic difficulties of the region which prevented us to reach more individuals during our study period. Since the aim of the project was to reach as many individuals as possible in a limited time, it was not possible to visit the same region the next year, to see the outcomes of our visit the year before. This way, it would be possible to compare the incidences of parasitic infections in children, and check whether training of children

for hygiene and adults for back pain care (only in 2015) improved health quality. It is planned to visit Nagarkot this and/or next year, and the data may help us compare the outcomes of the previous visits.

In conclusion, our three-year, voluntary field study, conducted in different regions of Nepal, has produced new data about certain parameters of physical examination and laboratory tests (including the prevalence of intestinal parasites) in a total of 1148 Nepalese citizens. In addition, observations during site visits were shared to address the existing health hazards in rural Nepal. Difficulty in accessing safe food and drinking water, high prevalence of infectious agents, inadequate knowledge of residents on healthy life practices and low sanitation standards contribute to failure to thrive in children and morbidity in adults. It is essential for governmental departments, and even voluntary organizations, to work in harmony to improve the infrastructure of villages and cities, and maintain the safety of food, water and environment for all the citizens of Nepal. The volunteers in this project wanted to contribute to this activity by training both young children in basic hygiene and healthy living principles and adults in First Aid and Organization after Natural Disasters. Maintenance of such programs in rural Nepal will no doubt improve the vigilance among healthcare professionals and citizens about healthy practices in their daily lives.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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