Introduction

From 11 to 17 June 2012, a team from Medical Checks for Children (MCC) checked and treated 892 children, aged 18 years and below, free of cost. This mission was the second MCC mission to the Ladakh Region, which was visited by MCC for the first time in July 2011. The mission was organized on invitation by and in collaboration with the following local partners: the local non-governmental organization PranaPlanet, Dr Nordan Otzer (Sub District Hospital, Disket, Nubra valley). Official approval for the mission was requested and obtained from the Ladakh Autonomous Hill Development Council. The mission's objective was to assess the general health status of children in the region; provide basic health care, free of cost; and raise awareness of health, hygiene, and nutrition. The mission was made up of two parts: 1) follow-up of locations in the India valley (11–13 June) visited during the previous MCC mission in July 2011; 2) first time visit to Nubra valley (15–17 June).

The MCC team consisted of ten members from The Netherlands most of whom had already participated in earlier MCC checks elsewhere (marked with an asterisk below). Medical doctors on the team were Willemijn Jager (resident paediatrics), Gijs Baaten (general physician in training*), Ilonka Brugemann (general physician*), Rosa Immink (emergency physician in training), and Luc Coffeng (MD, epidemiologist*). The team was completed by Dave Lemstra (forensic psychiatric nurse*), Elske Hartong (physician assistent), Dax Vendrig (veterinary pharmacologist*), Marianne Huibregtse-Schouten (paediatric research nurse), and Hans van Loon (family coach*). The team was coordinated and led by Hans van Loon (logistic mission leader) en Luc Coffeng (medical mission leader).

Technical equipment for the health checks was brought from Europe by MCC team members. Medication and other supplies such as gauzes were ordered through the internet from Sonam Dawa, pharmaceutical wholesaler in Leh, Ladakh.

This report summarizes the medical findings of MCC's mission in the Ladakh region and aims to provide a second set of recommendations and action points for improving the health of children in the Ladakh region, following up on the first set of recommendations that was provided in the report on the previous mission (July 2011).

Check-up procedure

The medical checks where performed at four locations: the Alchi Institute in Alchi (11 June) and the New Millennium school in Leh (12–13 June) in the Indus valley, and the Goodwill Army School in Hunder (15 June) and the Lamdon School in Disket (16–17 June) in the Nubra valley. Prior to the start of the mission, local partners announced the mission at schools in the area, asking that children be presented in presence of their guardians. Also during the mission, local partners and volunteers again went to the candidate schools and communities, asking local leaders to present the communities' youngest and sick children first, in presence of their guardians. During the mission, children came to the mission location by foot or were picked up by a school bus and brought there.

Once the children had arrived at the mission location, they were given a numbered case report form and were admitted to the first station where their name, age and a preliminary medical history were written on the form by local volunteers. If the child was known to have been checked by MCC in 2011 (confirmed either by child, teacher, or guardian), the previous year's case report form was looked up and stapled to the new form. If the child went to school, the school was recorded; if the child did not go to school, the place where the child lived was recorded. Table 1 describes the number of children that were seen at each location, subdivided by school and place of stay. A unique MCC-number was allocated to each child to make future follow-up possible. The case report form was then given to the child who kept it until his or her medical check-up had been completed. At the next station, children had their weight, height, and haemoglobin levels (Hemocue) assessed. The CDC criteria for anaemia[1] were used for assessing haemoglobin levels, adjusted for long-term exposure to high altitude.[2] Each child was physically examined by one of the medical doctors. Doctors prescribed treatment when needed (in most cases for anaemia, vitamin

[1] *CDC criteria for anaemia in children and childbeating age women*. MMWR, 1989, 38:400-404.

[2] Adapted from Hurtado et al. *Influence of anoxemia on haematopoietic activities.* Archives of Internal Medicine, 1945 75:284-323.

deficiency, or prophylactic anti-worm treatment). Medication was dispensed on site (if necessary and available) upon turning in the case report form. In addition, every child got a toothbrush, toothpaste, and a bar of soap on site upon turning in the case report form. In case of dental problems, children were referred for dental check-up at a third-party dental camp that was to take place a few weeks later. Children with severe acute dental problems were referred to the government hospital in Leh. All data were digitally registered on location.

As with all medical missions, we made efforts to include local volunteers (medical workers, teachers, students etcetera) in helping with translation during the check-up and taking care of the children.

Table 1: Overview of number of children checked by school or place of stay, date, and location of checks.

School or place of stay of checked children	Date of checks	Location of checks (altitude considered when checking haemoglobin levels)	Number of children examined
Moravian School, Kalsi	11 June 2012	Alchi Institute, Alchi (3500 m)	78
Alchi Institute, Alchi; Likir and surroundings	06/11/12	Alchi Institute, Alchi (3500 m)	
Alchi Institute, Alchi; Likir and surroundings	06/12/12	Wilad Guesthouse Likir (3500 m)	
Riglam School, Leh	12 June 2012	New Millennium School, Leh (3500 m)	45
New Millennium School, Leh	12–13 June 2012	New Millennium School, Leh (3500 m)	57
Kunfan Modeling School, Leh	13 June 2012	New Millennium School, Leh (3500 m)	11
Police Public School and Mission School, Leh	13 June 2012	New Millennium School, Leh (3500 m)	2
Druk Padma School, Leh	13 June 2012	New Millennium School, Leh (3500 m)	144
BVN School, Leh	13 June 2012	New Millennium School, Leh (3500 m)	44
Goodwill Army School, Hunder	15 June 2012	Goodwill Army School, Hunder (3000 m)	173
Lamdon School and surroundings, Disket	16–17 June 2012	Lamdon School Disket, Disket (3000 m)	246
Total	11–17 June 2012		892

Table 2: Number of checked children per age category, gender, and school(s) or area. Because of the small number of checked children from the Riglam and Kunfan Schools, the data from these schools have been merged for this overview. The two children from the Police Public School and Mission School in Leh are not listed separately.

	Morav. School	Alchi Inst. and Likir	New Mill. School	Riglam and Kunfan Schools	Druk Padma School	BVN School	Goodw. Army School	Lamdon School	Total	
Total	78	92	57	56	144	44	173	246	892	100%
Age										
<1	0	0	0	0	0	0	2	7	9	1%
1 – <5	7	25	21	6	22	16	52	31	181	20%
5 – <7	12	26	16	30	79	18	82	61	324	36%
7 – <9	6	35	18	17	30	9	26	87	239	27%
9 – <12	37	5	2	3	13	1	9	54	124	14%
12 – <18	6	1	0	0	0	0	2	6	15	2%
Boy	41	51	28	33	81	26	96	128	486	54%
Girl	37	40	29	23	63	18	74	117	401	45%
Missing data	0	0	0	0	0	0	3	0	3	0.3%

Diagnoses and treatments

A total of 892 children were checked during the mission (Table 2). Due to the high risk of mortality and morbidity under five years of age in developing areas, the focus of MCC is checking young children. Off all checked children, 85% of the children were twelve years or younger (68% in 2011), and only 20% of the children were below five years of age (7% in 2011; table 2). The majority of the cases that received our attention were anaemia (67%; 74% in 2011) and growth retardation (24%; 31% in 2011). Most ailments could be treated on the spot. However, a number of children were referred to the government hospital in Leh for further

diagnoses and/or treatment. Below we will describe these matters in more detail. It should be noted that differences between this mission's overall findings and that of last year are most likely due to the fact that this year, the checked children were much younger on average than last year. To check differences between this and last year's findings, we compare this and last year's findings in children of similar ages, where possible.

Growth retardation

We assessed the growth status of each child by measuring his/her height and weight. Growth retardation was suspected when the measurements were very different from expected height and weight, given a child's age and gender. In developing areas, growth retardation is most often a sign of insufficient nutrition. Therefore, all cases of growth retardation were regarded as cases of malnutrition, unless there were signs for other possible explanations (e.g., tuberculosis, thyroid dysfunction, or heart murmurs). Growth retardation was assessed in three ways: 1) comparing height to expected height, given a child's age (possible up to the age of 18); 2) comparing weight to expected weight, given a child's age (possible up to age 10); 3) comparing the weight to expected weight, given a child's height (possible up to height of 120 cm). Growth retardation was diagnosed when a child's height and weight were among the bottom 3% lowest expected values (at or under the third percentile; meaning that about 97% of all healthy children in the world are probably taller and heavier).

Overall, 24% of the checked children were not tall enough for their age, indicating chronic insufficient nutrition (Table 3). In 2011, 31% of the checked children were not tall enough for their age. This difference was entirely due to the fact that this year, checked children were younger, and due to the fact that the percentage of children that are not tall enough for their age increases with age (both last year and this year).

In the children up to the age of ten, 17% was not heavy enough for their age, again indicating chronic insufficient nutrition (Table 3). In 2011, 27% of the checked children were not heavy enough for their age. This difference was again entirely due to the fact that this year, checked children were generally younger, and the fact that the percentage of children that are not heavy enough for their age increases with age (both last year and this year).

Of the children up to height of 120 cm, 5% was not heavy enough for their length, indicating that they had recently lost weight (Table 3). In 2011, 10% of the checked children were not heavy enough for their length. The difference should be interpreted while taking account of the following:

1. In 2011, only 246 children up to the height of 120 cm were checked, whereas this year 711 children up to that length were checked. Therefore, this year's estimate may be more precise than last year's, and last year's estimate may deviate by chance;
2. In children of approximately the same age, the percentage of children with low weight for height had decreased in at least one school (Druk Padma School). In other schools, not enough children up to a height of 120 cm were checked in 2011 to allow for sensible comparison;
3. In general, it seemed that the prevalence of low weight for height had decreased in all age groups between 2011 and 2012. This may be due to better, healthier food, hygiene, anti-worm treatment, and aneamia treatment.
4. It is possible that this year, we checked a different sub-population of children than last year (i.e. selection bias). Last year, it may have been the case that for some school (such as for the Druk Padma School), there was a selection of children towards more growth retardation (e.g. "sick and weak children first"), and that this selection was less severe this year.

Possible remedies for growth retardation are: 1) better nutrition, including more vegetables and fruit in the daily diet; 2) treat and prevent intestinal worm infection (hand washing), especially in children under five; 3) introduction of solid food in a baby's diet at six months of age (breastfeeding is good, but not if it is given on its own for too long because then the baby will miss nutrients from solid foods) ; 4) educate children, teachers, and parents about the above.

Table 3: Growth abnormalities, per school or area. Findings of the previous year's mission (July 2011) are presented in parentheses, where applicable. Because of the small number of checked children from the Riglam and Kunfan Schools, the

data from these schools have been merged for this overview. The two children from the Police Public School and Mission School in Leh are not listed separately.

	Morav. School	Alchi Inst. and Likir	New Mill. School	Riglam and Kunfan Schools	Druk Padma School	BVN School	Goodw. Army School	Lamdon School	Total (n / N and %)	
Height for age P3	42.0% (N.A.)	17.0% (22-23%)	30.0% (42%)	35.0% (32-52%)	34.0% (29%)	30.0% (17%)	20.0% (N.A.)	21.0% (N.A.)	214 / 891	24.0%
Weight for age P3	35.0% (N.A.)	9.0% (22-29%)	25.0% (30%)	20.0% (29-35%)	12.0% (27%)	16.0% (21%)	21.0% (N.A.)	13.0% (N.A.)	147 / 864	17.0%
Weight for height P3	4.0% (N.A.)	1.0% (8-13%)	6.0% (14%)	10.0% (7-10%)	5.0% (11%)	5.0% (0%)	7.0% (N.A.)	1.0% (N.A.)	33 / 711	5.0%

Height for age was evaluated in all children; weight for age was evaluated in children up to the age of 10 years; weight for height was evaluated in children up to a height of 120 cm.

Anaemia

Anaemia (low level of haemoglobin) is the most prevalent micronutrient disorder in developing areas. The most important causes of anaemia are malnutrition and worm infection, and more rarely chronic infectious diseases such as tuberculosis and HIV. Anaemia causes fatigue, reduced ability to concentrate and learn in school, and consequent delay in a child's cognitive development. Therefore, anaemia has significant effect of the future of a child. In India, no national policy has been implemented to provide iron supplements to pregnant women or young children. Furthermore, even though there are worm-treatment programs in India, none of the children that we checked reported receiving regular anti-worm treatment.

Table 4: Anaemia prevalence among children from whom successful blood samples were obtained.

School / area	Number of anaemic children / number of examined children in 2012	Prevalence of anaemia (%) in 2012	Prevalence of anaemia (%) in 2011
Total	599 / 892	67%	74%
Moravian School	59 / 78	76%	N.A.
Alchi Inst. and Likir	73 / 92	79%	67%
New Millennium school	46 / 57	86%	77%
Riglam and Kunfan schools	44 / 56	79%	81%
Druk Padma school	122 / 144	85%	85%
BVN school	35 / 44	80%	65%
Goodwill Army School	93 / 173	54%	N.A.
Lamdon School	122 / 246	50%	N.A.

In all age categories in all schools and areas in the Indus valley, prevalence of anaemia was >70%. In the Nubra valley, prevalence of anaemia was generally lower (30–70%.)

Overall, about two thirds of the checked children had low levels of haemoglobin. In the Indus valley, boys and girls, and children of all ages were affected similarly (at least 70%), indicating the magnitude of the problem. These findings in the Indus valley were comparable to last year's findings. In the Nubra valley, prevalence of anaemia was generally lower (50% on average), although prevalence of anaemia increase with age (60–70% in children aged <5; 40–50% in children aged 5–7; 35–45% in children aged ≥7). The most likely explanation for this difference is that the altitude correction of haemoglobin levels may have been inappropriate / unnecessary. Nubra valley was considered to be about 500 meters lower than the Indus valley, meaning that we used lower haemoglobin thresholds for anaemia for children from the Nubra valley (Nubra children were allowed to have lower haemoglobin).

However, the actual haemoglobin levels were very similar in the two valleys (comparing children of the same age and sex).

Possible remedies for anaemia are: 1) better nutrition, including more vegetables and fruit in the daily diet; 2) treat and prevent intestinal worm infection (hand washing), especially in children under five; 3) introduction of solid food in a baby's diet at six months of age; 4) educate children, teachers, and parents about the above. When we diagnosed anaemia in a child, the standard treatment was iron suppletion, which was given for three months. If a child also suffered from growth retardation or showed signs of a chronic infection, multivitamins were prescribed instead of iron (based on prior field experience). If a baby was anaemic, multivitamin drops were prescribed for the baby and iron supplements for the mother. In addition, we tried to educate children, teachers, and guardians about the importance of preventing anaemia, and how to do it.

Worm infections

Intestinal worm infections are an important cause of anaemia and growth retardation in developing area. Intestinal worm infection can be contracted by contact with stools or soil that is contaminated with worm eggs (oral or skin contact such as walking bare feet). Soil becomes contaminated by stools of infected persons (i.e., lack of sanitation). Worm eggs in contaminated soil stay infective for years! A major preventive measure for worm infection (and concomitant anaemia) is hygiene: washing of hands with soap after toilet visits and before meals or preparation of food; enclosed, clean toilet facilities; hygienic food preparation; combined with treatment of active worm infections (bloated bellies; see a doctor) and preventive treatment of all children of age 2 to 12 with albendazol (400 mg) or mebendazol (200 mg) twice a year. Preventive treatment is most important for children under five.

In the Ladakh region, we identified 27 cases of major worm infection (bloated belly), which was more than last year (one case only). Most of these cases were between five and twelve years old (18 cases), the minority of cases was below five years of age (nine cases). Because without examination of stoo, major worm infection is a difficult, subjective diagnose, it is likely that this year's higher number of suspected cases was due to the fact that we had different doctors on the team. Last year, we hypothesizes that the low prevalence of worm infection may have been due to the typical Ladakhi toilet, which is clean by its nature and may prevent worm infections. This may still hold. On the other hand, there may still be many children with intestinal worms who remained undetected during our checks, given the lack of a regular anti-worm treatment program. Therefore, all checked children were given preventive treatment (albendazol 400 mg). We recommend that all schools repeat this treatment after twelve months.

Pneumonia and tuberculosis

Pneumonia and tuberculosis are still on the list of leading causes of child mortality. A total of three children were diagnosed with pneumonia and treated with antibiotics. No cases of suspected tuberculosis were seen. The number of children with pneumonia and tuberculosis was surprisingly low compared to previous missions in Spiti, a region that is comparable to Ladakh in terms of school and health system. This difference may indicate that Ladakhi children are generally healthier. Last year's findings were similar, though we then thought we might have seen few cases of pneumonia and tuberculosis because the checked children were relatively old. However, this year we checked a large number of younger children, and still we found few cases of pneumonia and no cases of tuberculosis.

Table 5: Disease in the examined children, per school / area (number of cases with prevalence between brackets).

	Active worm inf.	Caries with pain	Scabies	Vitamin deficient	Pneu-monia	TBC	Path. heart murmur	Chronic kidney path.
Morav. School	0 (0%)	17 (22%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Alchi Inst. and Likir	1 (1%)	22 (24%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	0 (0%)

New Millennium school	5 (9%)	15 (26%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2%)	0 (0%)
Riglam and Kunfan Schools	1 (2%)	19 (34%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Druk Padma School	8 (6%)	30 (21%)	0 (0%)	8 (6%)	1 (<1%)	0 (0%)	6 (4%)	0 (0%)
BVN School	1 (2%)	13 (30%)	0 (0%)	1 (2%)	0 (0%)	0 (0%)	1 (2%)	0 (0%)
Goodwill Army School	4 (2%)	31 (18%)	0 (0%)	2 (1%)	0 (0%)	0 (0%)	1 (<1%)	0 (0%)
Lamdon School	7 (3%)	37 (15%)	0 (0%)	2 (1%)	2 (<1%)	0 (0%)	1 (<1%)	1 (<1%)
Total	**27 (3%)**	**185 (21%)**	**0 (0%)**	**13 (1%)**	**3 (<1%)**	**0 (0%)**	**12 (1%)**	**1 (<1%)**

Pathologic heart murmurs

Twelve children were suspected of having a pathological heart murmur. All children were referred for check-up by a dentist (a pathologic hear murmur combined with bad dental condition may lead to rheumatic valve disease) and were sent to the paediatrician at the government hospital.

Proteinuria

Only one case of suspected chronic kidney pathology was found and referred to the Leh government hospital for further testing.

Caries

Dental health is important for the well being of children in several ways. Low dental health may lead to inflammation and pain, which in turn may lead to reduced appetite (important for anaemia and growth retardation), reduced ability to concentrate in class, and even rheumatic heart disease in children with heart valve defects (heart murmur).

Because this year, the MCC was without dentists, we referred all children with dental problems to a third-party dental camp that was scheduled to take place a few weeks later. In general, the dental health and hygiene in children was very low in all schools. In general, 21% of children reported having tooth pain. Many of the children indicated that they only brushed once a day before breakfast. In the Indus valley, relatively more children reported dental pain (20–30%) than in the Nubra valley (15–18%, which is most likely due to higher consumption of sugar-containing foods and drinks in the Indus valley, associated with its urbanization.

We advice the following for improvement of dental health of children. Some of these advices were already discussed with school boards during the mission. 1) Ban sweets from school grounds. 2) Schedule moment for toothbrushing at school in the morning, after breakfast and before the daily opening ceremony. 3) Assign upper class students in school as tooth-brushing mentor for younger children in the school, so that they may instruct and help the younger children brushing their teeth. We were very happy to hear that the New Millennium School has adopted this strategy. Unfortunately, we did not have the means (i.e. a dentist) to adequately check whether this had improved the dental health of the children. Nevertheless, we encourage the New Millennium School, and all other schools, to take up and sustain this initiative. 4) Schedule moment for toothbrushing in the evening after dinner for those children staying at school hostels, making hostel mothers responsible for supervision of the tooth brushing. 5) Children should use toothpaste that contains fluoride and schools supplying toothpaste to their students should check this. 6) Educate children about the importance of dental health.

Table 6: Number of referrals to the hospital.

	Anaemia	**VI**	**Other (specifics per case)**

Morav. School	0	1	
Alchi Inst. and Likir	1	3	Anxiety/epilepsy? (1); heart murmur (1)
New Millennium school	0	1	Unidentified pulmonary problem (1); Heart murmur (2);
Riglam and Kunfan Schools	4	1	Extreme low anaemia with Hb <5.0 mmol/l (1)
Druk Padma School	4	3	Heart murmur (4); plastic surgery (1);
BVN School	0	2	Epilepsy (1); heart murmur (1)
Goodwill Army School	2	1	Heart murmur (1)
Lamdon School	2	1	Strabismus (1); heart murmur (2); returning retinoblastoma (1); stammering (2)

Anaemia = follow-up for severe anaemia after three months of treatment; VI = get glasses for visual impairment.

Referrals

A total of 33 children were referred to the Leh government hospital for further evaluation and treatment (Table 6). Children complaining of trouble reading due to visual impairment (13 cases) were also referred to the ophthalmologist for glasses. For children staying at the New Millennium school hostel, any additional costs for referral, treatment or glasses were vouched for by the school.

Education of health workers, caretakers and other local helpers

One of the important tasks of MCC is to encourage the continuation of education of the caretakers and older children. During our week we had teaching sessions on common diagnoses of frequent illnesses and medication. We especially focused on anaemia and malnutrition, on balanced diet, hygiene, dental health, infection, parasites and failure to thrive. Our information mainly consisted of knowledge and practical advice about nutritious food and vitamin supplements, as well as hygienic and health promotion issues.

Future medical needs

- On all the locations visited, there is a strong need for comprehensive and systematic health promotion and preventive measures. Special emphasis needs to be put on personal hygiene, dental care, good eating habits and nutritious food (more vegetables and (dried) fruits!).
- Last year, we recommended that all children up to the age of twelve should be de-wormed every six months. However, after having seen younger children this year, it our impression that worm infection is not as big a problem as previously thought. Therefore, we now recommend that it should be sufficient to de-worm all children up to twelve years of age every year (instead of every six months).
- As far as we know, there is no vitamin A program in the Ladakh region. In recent years, scientists have found that vitamin A suppletion lowers child mortality. We therefore, we urge the Ladakh Autonomous Hill Development Council to consider such a program. Medical Checks for Children would be happy to advice in the matter.
- We recommend that during the winter, children are given vitamin supplements. As an inferior alternative, we recommend that children take such supplements after they come back from their winter break, which may be necessary as it may not be feasible to have children take these supplements when they are away from school, visiting their parents. A challenge to overcome is to find a suitable vitamin supplement for children. Many supplements contain either too little or too much of the essential ingredients. During the current mission, we mainly worked with supplements that were lacking in one or more essential ingredients (e.g. vitamin A). We will do our best to

make an inventory of all available vitamin supplement types in the region, and will base a more detailed advice on this.

Last words

We are grateful to all the schools, parents, care takers and community people for bringing the children and helping to conduct the program. We are happy we got the opportunity to work with and to learn from all volunteers, translators and other supporting members who have helped directly or indirectly, despite their own obligations. We are looking forward to revisiting Ladakh in 2013, when we will be working together with the same partners as in 2012. In addition, we are looking forward to working with the Ladakh Buddhist Association (LBA) Women's Wing on a workshop about health education of several days.

We enjoyed working together with the teachers, health workers and senior students of all the schools that we visited. We hope they will continue to inspire their communities in the same way they inspired us. They play a vital role in spreading awareness and knowledge about health and its importance for children in reaching their developmental potential. And last but not least, we would like to thank the children who came to the checks for their inspiring presence.

Luc Coffeng, M.D., epidemiologist
Mission leader MCC mission Ladakh 2012

Utrecht, 19th of November, 2012