



Discussion

Afghan refugees and the temporal and spatial distribution of malaria in Pakistan

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Abstract

Influx of refugees and establishment of camps or settlements in malaria endemic areas can affect the distribution and burden of malaria in the host country. Within a decade of the Soviet invasion of Afghanistan and the arrival of 2.3 million Afghan refugees in Pakistan's North West Frontier Province, the annual burden of malaria among refugees had risen ten fold from 11,200 cases in 1981 to 118,000 cases in 1991, a burden greater than the one reported by the Pakistan Ministry of Health for the entire Pakistani population. Political developments in the 1990s led to over half the refugee population repatriating to Afghanistan, and the Afghan Refugee Health Programme (ARHP) was scaled down proportionately. Districts in which the ARHP recorded a reduced incidence of malaria began to show an increased incidence in the statistics of the Pakistan government health programme. This and other evidence pointed to a change in health seeking practices of the refugees who remained in Pakistan, with many turning from ARHP to Pakistani health services as aid declined. Comparison of the two sources of data produced no evidence for the spatial distribution of malaria in NWFP having changed during the 1990s. Nor was there any evidence for the presence of refugees having increased the malaria burden in the Pakistani population, as is sometimes alleged. This highlights the risk of misinterpreting health trends when parallel health services are operating. Over the decade incidence in the refugee camps decreased by 25% as a result of control activities, and by 1997 the burden among remaining refugees had fallen to 26,856 cases per annum. These trends indicate that the burden would continue to fall if political conditions in Afghanistan were to improve and more refugees returned to their homeland. © 2001 Published by Elsevier Science Ltd.

Keywords: Malaria; Refugees; Pakistan; Afghanistan

Introduction

Migration of refugees from one country to another can affect the distribution and incidence of malaria in various ways. When coming from a malaria endemic area, refugees may transport malaria parasites or new strains of parasite to the host country. The parasites may stimulate outbreaks if the new environment is suitable for transmission (Najera, 1996). When coming

from a non-endemic area to an endemic area, refugees may be more vulnerable to local transmission than the host population, since refugees will lack natural immunity to native strains and have added problems of malnourishment and stress to compound the risk (Toole & Waldman, 1990; Boss, Brink, & Dondero, 1987). Epidemic conditions arise when the health infrastructure of the host country is over-stretched and non-immune immigrants are settled onto sites capable of supporting mosquito breeding.

When two and a half million Afghan refugees fled to Pakistan between 1979 and 1982 to escape the war with the Soviet Union, they were leaving a country which

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1 until that crisis had one of the more successful malaria
 3 control programmes in Asia (Buck et al., 1972).
 5 Pakistan, on the other hand, was emerging from a
 7 malaria epidemic in the mid 1970s that had produced
 9 over two million cases in the Punjab (Zulueta, Mujtaba,
 11 & Shah, 1980). The refugees had arrived in a country
 13 where malaria was highly endemic, and with a health
 15 system that was unable to cope with the influx. The
 17 refugees were rapidly settled into more than 300 camps
 19 sited on marginal lands running the length of NWFP
 21 and Balochistan provinces. Camps unfortunate enough
 23 to be sited on the waterlogged margins of rivers, or
 25 adjoining rice irrigation, were particularly prone to
 27 mosquito breeding and malaria, whereas camps situated
 only a few kilometres away on dry wasteland or scrub
 had little or no malaria (Rowland, Durrani, Hewitt, &
 Sondorp, 1997a; Rowland, 1999). Kazmi and Pandit
 (2001) have recently undertaken a spatial analysis of the
 distribution of malaria in NWFP that uses adminis-
 trative districts as the unit of resolution. Using
 consolidated records of the Pakistan Malaria Control
 Programme and public health services, they show
 changes in the pattern of malaria between districts
 during the period 1972–1997. They argue that the 20-
 year presence of refugees has wrought environmental
 degradation and long-term changes to the ecology and
 distribution of the disease in the country.

Such opinions are not new. In the decade after arrival
 Afghan refugees were sometimes blamed for bringing
 malaria to Pakistan when there was little hard evidence
 for this. On the contrary, systematic parasite surveys
 indicated that new refugees lacked immunity and were
 more vulnerable to malaria transmitted within Pakistan
 than the local inhabitants appeared to be (Suleman,
 1988; Zulueta, 1989; Bouma, 1996). The broad brush,
 district resolution analysis of Kazmi and Pandit (2001) is
 unable to take into account local variation in malaria
 between camps within the same district. Such variation
 may be considerable and is important to the argument.
 District-level analysis would be more acceptable if the
 data captured a representative sample of the malaria
 occurring within each district. Unfortunately their data
 can only tell part of the story because only the records of
 public sector facilities run by the Pakistan Ministry of
 Health (MoH) were accessed, whereas refugees more
 often used the health facilities run by the United Nations
 High Commissioner for Refugees (UNHCR) and non-
 governmental organisations (NGO) inside the camps
 (Shah et al., 1997), and records from those facilities were
 reported to a different health authority unaccessed by
 Kazmi and Pandit (2001).

In the study reported here we analyse the records of
 malaria diagnosed at refugee camp basic health units
 (BHU) between 1990 and 1997, a period in which
 malaria was being routinely and reliably diagnosed by
 microscopy and records systematically collated by the

UNHCR Afghan Refugee Health Programme (ARHP). 57
 We compare this database with the malaria records of 59
 government health facilities run by the Pakistan MoH in 59
 the same districts. We show an inverse correlation in 61
 district-level incidence recorded at MoH facilities 61
 compared to that recorded at ARHP facilities. We find 63
 no evidence for significant changes in the spatial 63
 distribution of malaria in NWFP during the decade. 65
 However, in Pakistan as a whole, there is evidence for a 65
 long-term, gradual increase in reported malaria, even in 67
 the two eastern provinces of the country (Punjab and 67
 Sindh) where refugees were never residing in large 69
 numbers. 69

71 Background 73

75 *Conflict and refugees*

The 23-year conflict in Afghanistan has gone through
 several stages. On taking power in 1978 the new
 communist regime of the People's Democratic Party
 (PDPA) began imposing unpopular social reforms with
 unwarranted severity (Gilardet, 1998). These were
 followed by purges, arrests and assassination of
 dissidents from across Afghanistan's political and
 religious spectrum. This provided the impetus for a
 nationwide uprising by rebels (or mujahideen as they
 became known). Soviet troops invaded in December
 1979, and joining forces with Afghan regime troops were
 responsible for massive destruction of countryside and
 villages during their 10-year occupation. The brutality
 provoked a call for holy war or jihad which justified not
 just the taking up of arms but also a process of
 migration, on the religious grounds that believers had
 been wronged (Marsden, 1998). One third of the Afghan
 population, 6.2 million, fled the war to Pakistan and
 Iran, causing whole regions to be abandoned. After
 arrival in Pakistan, the 2.3 million refugees were settled
 in 248 camps running the length and breadth of North
 West Frontier Province (NWFP), a further 0.8 million
 settled in Balochistan province to the south, and 0.1
 million in Punjab province to the east. About 50% of
 camps were sited in the Tribal Areas, a semi-autono-
 mous territory running along the Pakistan–Afghanistan
 border (Fig. 1). These areas operated tribal law, and
 were relatively undeveloped compared to government
 administered districts to the east.

Red Army troops withdrew in 1989, and fighting in
 Afghanistan reverted to civil conflict between mujahid-
 een and communist government forces. The government
 finally fell to the mujahideen in 1992, and an estimated
 1.6 million refugees returned home. Factional fighting
 between rival mujahideen groups devastated the capital,
 Kabul, in 1993–94 with little regard to inhabitants, and
 up to million internal refugees (internally displaced
 111

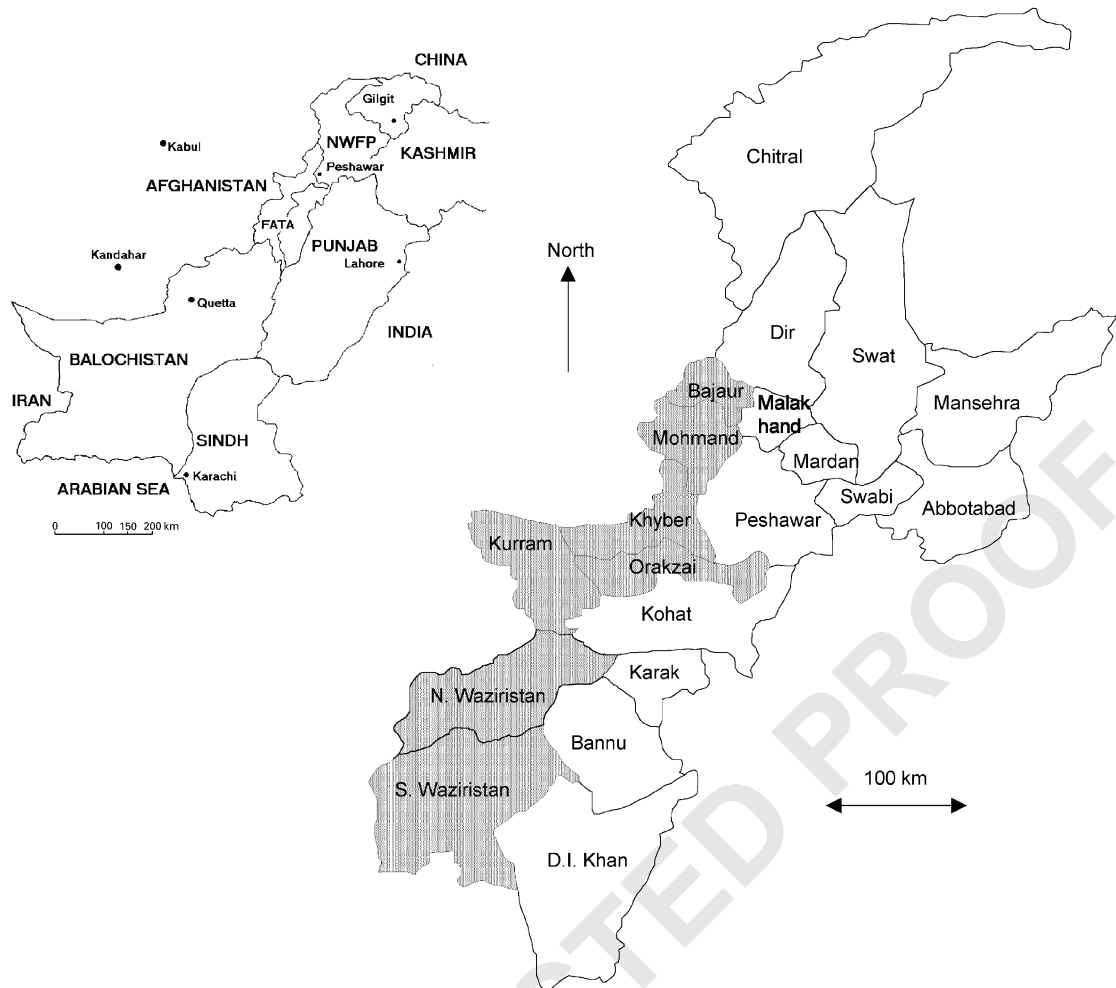


Fig. 1. North West Frontier Province, Pakistan (Tribal Areas shown in darker shade). Map of Pakistan showing position of the provinces and Afghanistan.

persons) fled to other parts of the country (by then the Pakistan government was less supportive and the border was closed to new refugees). Meanwhile another 1.3 million refugees returned to peaceful rural areas of the country. The continued anarchy in the country provided an opportunity to the Taliban who emerged as a strong political and military force in 1994. Starting from their base, the southern city of Kandahar, they were able to bring almost 90% of the country under their control within 3–4 years. But the Taliban were unable to press home their early advantage, as the social and civil structure of the society remains torn, national development is at a standstill and fighting still continues in some central and north eastern regions. The refugee population exiled in Pakistan remains at 1–2 million, being unwilling to return while such difficult social and economic conditions persist.

When the refugees first arrived in Pakistan they were provided with tents, food, and fuel. They quickly built their own mud homes on site, and found casual work to supplement their rations (Christensen & Scott, 1988). Schools, clinics, and water supply systems were established. Over time rations were reduced and finally brought to an end in the mid 1990s when refugees were deemed self-sufficient at the level of the poorest in Pakistan. A significant proportion of families live at a very marginal level, going for long periods without work and dependent on the charity of neighbours in the camps (Marsden, 1996).

Malaria epidemiology

An average camp contained 10,000 people but larger camps might house over 30,000. Camps were mostly

sited on marginal land unsuited or unused for agriculture. Not all refugee sites were able to support mosquito breeding and malaria transmission. Site geography ranged from cool mountain valleys in the northern district of Chitral and Dir, to low altitude and humid flood plains in the central districts of Peshawar and Mardan, to scrub covered hills and river margins in Kohat and Kurram, to desert fringes in southern D.I. Khan and Balochistan (Fig. 1). Malaria in Pakistan is a focal disease, limited by altitude and temperature (Bouma, Dye, & van der Kaay, 1996a), the type of terrain and the availability of sites suitable for mosquito breeding (Rowland et al., 1997a). Camps prone to malaria could be found in every district and tribal area, the primary environmental determinants being water-logging and borrow pits (earth being removed for construction of mud homes), high water tables, seasonal flooding, nearby rice cultivation, and ill maintained tube wells and water channels (unpublished data). Similarly every district had camps in which the immediate environment was arid or too well drained and hence unsuited to anopheline breeding or malaria transmission.

Transmission of malaria in Pakistan is seasonal, and mostly occurs after the July–August monsoon (Rowland et al., 1997a). There are 2 peaks of *Plasmodium vivax* malaria per year, the spring peak being caused by relapses or delayed expression of earlier infections, and the summer–autumn peak by recent transmission (Fig. 2) (Gill, 1938; Rowland et al., 1997a). *P. falciparum* malaria tends to peak later in the year and makes up around 35% of all malaria cases (Bouma et al., 1996a; Shah et al., 1997). Malaria in Pakistan also shows long-term periodic cycles. This is a natural phenomenon and can occasionally lead to epidemics, a major one having

occurred in the Punjab in the mid 1970s (Zulueta et al., 1980). *P. falciparum* malaria is particularly unstable in Pakistan, this marking the northern edge of its range, and incidence fluctuates from year to year according to climate variation. Key risk factors for outbreaks are high rainfall in autumn, above average temperatures in November–December, and El-Nino events (Bouma et al., 1996a).

Soon after arrival the refugees abandoned their tents and constructed homes and walled compounds from mud and stone in the local style. Camps began to resemble rural Pakistani villages. Mud houses are a poor barrier to vector mosquitoes, besides which most people preferred to sleep outdoors in the hot humid summer months which inevitably led to increased man–vector contact. By the late 1980s a third of camps in NWFP had developed a malaria problem of sufficient magnitude to warrant vector control measures by UNHCR (Rowland et al., 1997a). Such camps were to be found in every district and tribal area, hence the wide distribution yet focal nature of the disease (Rowland, 1999).

Afghan refugee health programme

UNHCR, its Pakistan government counterpart known as the Project Director of Health (PDH) for Afghan Refugees, and several NGOs collaborate to provide a primary health care service to refugees comparable to that by government for the local population (Fig. 3). The ARHP is structurally and functionally separate from the government's national health programme for Pakistanis. At its height, in 1991, the ARHP comprised 108 BHU run by UNHCR and PDH, 105 BHU run by NGOs, 18 hospitals, and 46 field laboratories, to serve the 248 refugee camps of NWFP.

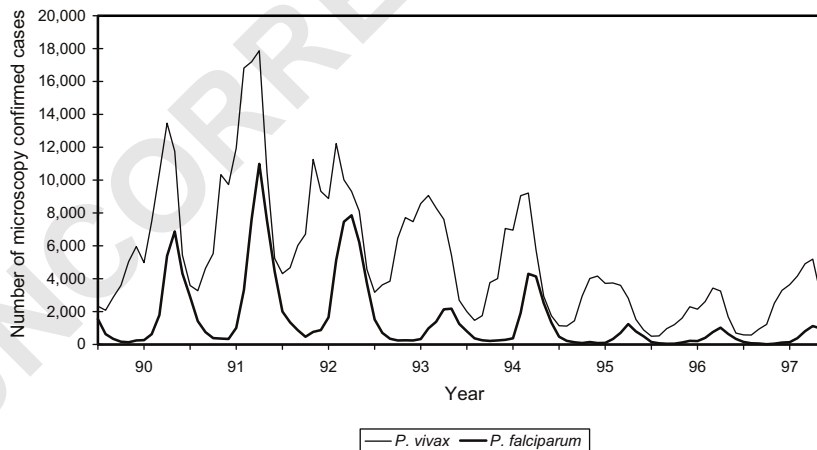


Fig. 2. Malaria in NWFP recorded by ARHP 1990–1997. Vivax malaria shows two peaks and falciparum malaria a single late peak per year. The number of cases have declined as control measure take effect, refugees repatriate to Afghanistan, and health services are scaled down.

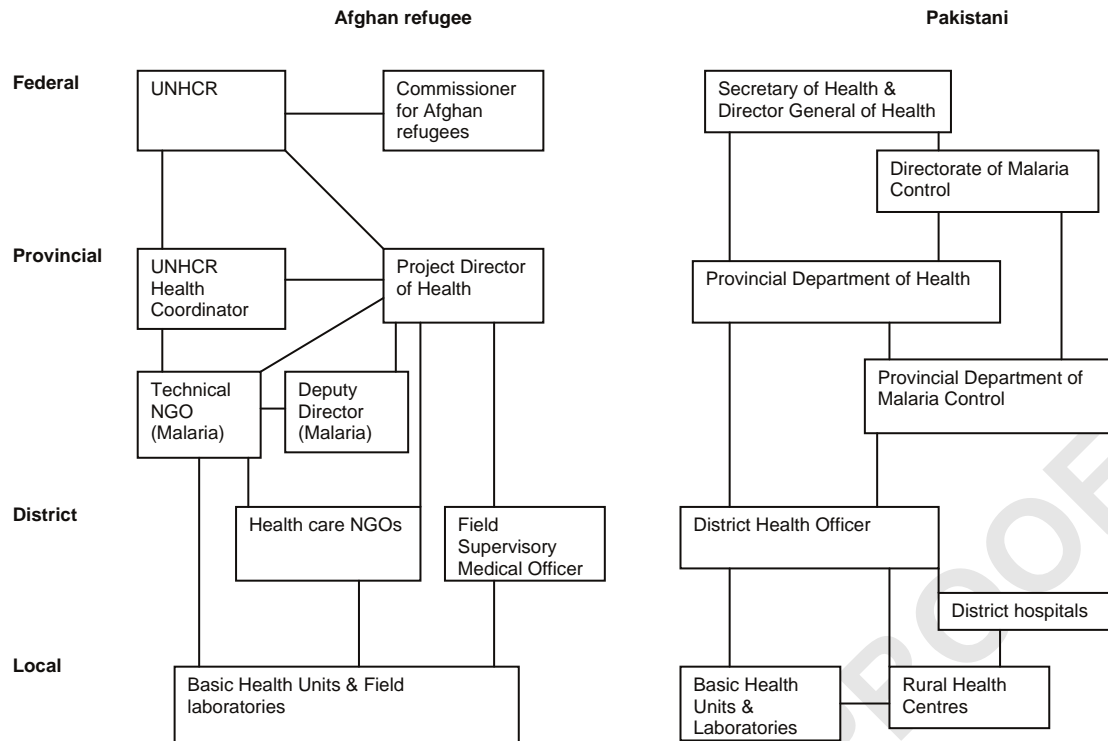


Fig. 3. Structures of the ARHP and the Government Health Programme for Pakistan, with emphasis on malaria control and clinical services.

UNHCR/PDH mainly operated BHU in the tribal areas, whereas NGOs ran BHU in the districts. Each BHU employed a medical officer, dispenser, lady health visitor, and malaria paramedic (among others), and provided curative, antenatal, and preventive services (e.g. immunization, sanitation, disease control) to 5000–15,000 refugees (Khan & Nesbitt, 1987). Administratively all the BHU and health programmes of a district or tribal area would come under the responsibility of a Field Supervisory Medical Officer, the ARHP equivalent of a district health officer. The aid programme was initially well funded and standards were high after several years of development and consolidation during the 1980s. Cases of malaria were diagnosed by microscopy (1 laboratory serving 5 camps) usually within 24 h of patients attending a BHU. Field laboratories were monitored each month by technical staff of a central reference laboratory run by HealthNet International (HNI). The quality control service involved re-checking a random sample of negative and positive slides and giving re-training to microscopists when required. This kept the accuracy of malaria diagnosis above 98% and ensured reliable record keeping (HNI, unpublished reports). Many BHU ran a network of trained volunteer health workers who provided a first point of contact, health education, and mechanism of referral. As the

BHU were always located within the camps and curative services were provided for free, the primary health programme treated a significant proportion of symptomatic malaria cases.

The HNI central reference laboratory compiled the malaria records in order to prioritise camps for malaria control. Camps recording the highest malaria incidence were sprayed with a residual insecticide applied to the walls and ceilings of houses (Rowland, Hewitt, & Durrani, 1994, 1997a). Those malaria records were used in the present analysis.

Government of Pakistan malaria control programme

The National Malaria Control Programme of Pakistan is largely decentralised to the 4 provincial governments, who integrate services for malaria diagnosis and treatment into the general primary health care system (Fig. 3). Specialised provincial malaria control departments are responsible for planning activities such as insecticide spraying and for compiling health information. National policy is to treat suspected malaria cases with chloroquine and to forward blood smears to district-level laboratories to confirm the diagnosis (most Pakistani BHU are not equipped with microscopes). Government health services are provided for free, but

owing to frequent delays in microscopical diagnosis, shortages of medicine, absenteeism, and difficulty of access, these services remain largely under-utilised and used only by the poor (Mills et al., 1998). Thus it is estimated that government services treat only 20% of the symptomatic malaria transmitted in the Pakistani population—the vast majority of cases are treated through the private sector (PMRC, 1998).

During the 1970s the highest incidence rates in NWFP were in the districts abutting the Punjab (where there was a major epidemic). In the mid 1980s the provincial malaria control programme expanded operations to the tribal areas in the west. Whereas the malaria burden appeared to shift westwards (Kazmi & Pandit, 2001), this was really an artifact caused by the tribal areas reporting malaria for the first time. The lack of data prior to this time means it is not possible to make inferences about the spatial distribution of malaria in NWFP between the 70s and 80s. In the non-tribal districts where a complete set of data did exist from 1970, there were no significant changes in spatial distribution over the next two decades (Kazmi & Pandit, 2001).

Results and discussion

Since the late 1970s the annual number of cases of malaria recorded by each of the 4 provincial departments of malaria control has gradually risen (Fig. 4a). Punjab province reported a sharp increase up to the mid 1980s, a downturn in the late 1980s, and a further increase in the 1990s. Sindh province and NWFP reported a steady increase in cases throughout the period, whereas Balochistan reported an upsurge during the 1990s. By themselves these trends would not be wholly convincing since they might reflect changes in operations or service utilisation. However the annual parasite rate (the ratio of confirmed malaria to all febrile illness initially suspected to be malaria before microscopical confirmation) also showed a steady increase over the two decades (Fig. 4b), and this form of presentation, in which malaria is expressed relative to other types of febrile illness, is more robust and not unduly affected by changes to the health system over the period.

The ARHP showed an even steeper rise in recorded malaria during the 1980s, and at its peak in 1991 over 118,000 microscopy-confirmed cases were treated in NWFP and 38,000 cases in Balochistan (Fig. 5a). The caseload in NWFP alone was greater than the one reported by the Government health department for the whole of Pakistan and four times greater than the load reported by the NWFP malaria control department. The difference seems even more remarkable when one considers that the refugee population in NWFP was

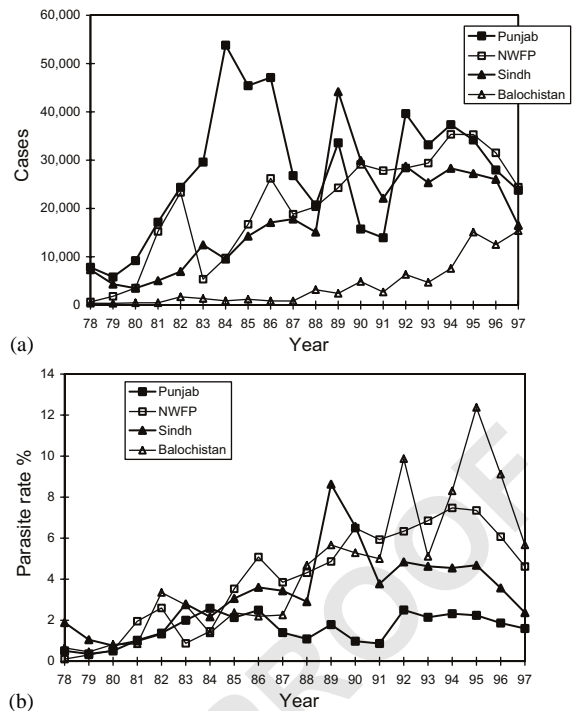


Fig. 4. (a) Cases of malaria recorded by the malaria control programmes of the Pakistan provincial health departments. (b) Annual malaria parasite rates (slide positivity rates) recorded by the malaria control programmes of the Pakistan provincial health departments. Data includes passively (clinic based) and actively (surveillance) detected cases.

only 2.3 million whereas the Pakistani population had reached 110 million at that time.

The refugee camps were almost entirely situated in NWFP and Balochistan provinces. There were no camps in Sindh province, and a mere 3% of refugees lived in the Punjab (and only during the winter months, because the Punjab group were nomadic migrating to S. Waziristan in NWFP each summer to seek work) (Bouma, Parvez, Nesbit, & Winkler, 1996b). Thus the rise in malaria reported in Punjab and Sindh cannot be attributed to the presence of refugees. Since Punjab and Sindh provinces covered the eastern half the country, the upsurge in malaria that occurred in all 4 provinces might conceivably be due to undetermined environmental causes that applied just as strongly to the western half—where refugees were located—as it did to the eastern half. Bouma et al. (1996a) showed that increased temperature—perhaps due to climate change—was a contributing factor to the rise in falciparum malaria in NWFP from the 1970s onwards. Increased autumn temperatures might also have contributed to the upsurge of vivax malaria, the more common species of malaria in Pakistan (Shah et al., 1997). The rapid spread of chloroquine resistant falciparum malaria across Paki-

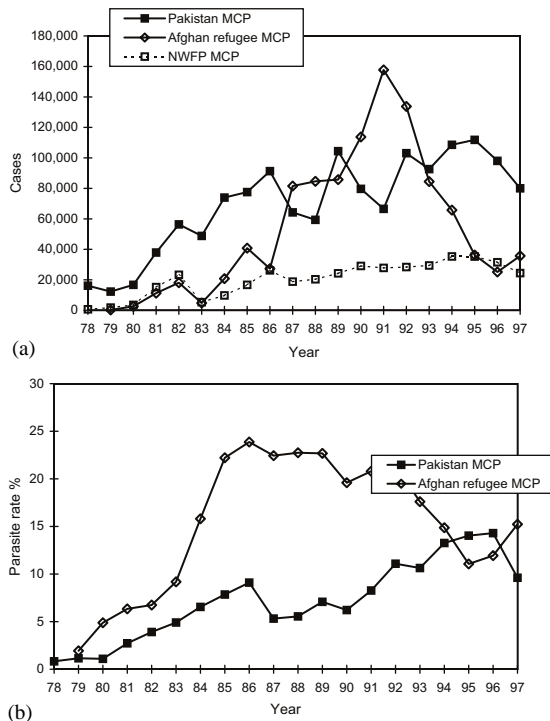


Fig. 5. (a) Cases of malaria cases recorded by the malaria control programmes of the Pakistan Ministry of Health (for Pakistanis), the NWFP Department of Health (for Pakistanis), & ARHP (NWFP, Punjab & Balochistan). (b) Annual malaria parasite rates (slide positivity rates) recorded by the malaria control programmes of the Pakistan Ministry of Health (for Pakistanis) & ARHP. Data only includes passively detected cases (clinic based).

stan during the 1980s also contributed, since resistance makes infections harder to eliminate by chemotherapy enabling further transmission (Shah et al., 1997; Rowland et al., 1997b).

Nevertheless the rise in malaria caseload and slide positivity rate does appear more pronounced for NWFP and Balochistan than for Punjab and Sindh provinces (Fig. 4), and we present evidence below that the presence of refugees in NWFP and Balochistan has contributed to the process. The critical question to consider is whether this was an direct effect due to refugees making increased use of Pakistan government health services or an indirect effect whereby the presence of refugees had somehow led to increased malaria transmission within the Pakistani population who then made increased use of government health services.

Kazmi and Pandit (2001) argue that the distribution of malaria had shifted from the southern and northern districts of NWFP in the 1980s to the western districts in the 1990s. They used Pakistan government health statistics (i.e. that of the provincial health services and malaria control programme) in their analysis and did

not have access to the 71% of malaria in NWFP that was reported through the ARHP. The latter needs to be incorporated and evaluated before any assertion can be fairly levelled at refugees. Thus we have analysed the refugee malaria and population data in exactly the same way as Kazmi and Pandit (2001) did for Pakistani health service data in order to compare the two. We calculated malaria incidence per 1000 refugees (malaria cases/population \times 1000) for each district for each year and then converted these rates to standardised values as follows:

$$SM_{it} = (M_{it} - M_t) / SD_t,$$

where SM_{it} is the standardised malaria incidence rate for district i in year t , M_{it} is the actual malaria incidence rate for district i in year t , M_t is the average malaria incidence rate for all districts in year t , and SD_t is the standard deviation in the malaria incidence rate in year t . The standardised values (Z -scores) were then converted to ranks whereby districts in which $Z \leq 0$ were categorized as 'below average incidence', $1.5 > Z > 0$ as 'above average incidence', and $Z \geq 1.5$ as 'well above average incidence'. The rank value for each district for each year from 1990 to 1997 was then examined using Spearman's rank correlation against the rank values for each district for the corresponding year from the analysis of government health service data. The result was a statistically significant negative correlation of -0.273 ($P = 0.036$). In other words where the government health service data showed above average incidence the ARHP data tended to show below average incidence, and vice versa (Fig. 6). Closer examination reveals that all refugee areas that ranked as 'well above average incidence' were in districts where government health service data showed 'below average incidence', 78% (21/27) of refugee areas that ranked as 'above average incidence' were in areas where government health service data showed 'below average incidence', and only 53% (15/28) of refugee areas that ranked as 'below average incidence' were in areas where government health service data showed 'below average incidence'. Similarly, of the 7 districts ranked as 'well above average incidence' with respect to government health service data, 86% (6/7) of these showed 'below average incidence' on the basis of ARHP data.

This inverse relationship may be interpreted in terms of changes in health seeking behaviour of refugees. Where camp BHU still existed the refugees would use these convenient and free health services, and the caseload reported by Pakistani health facilities for those districts would remain low. Where camp BHU were closed down as a result of cuts in aid some refugees would turn to the Pakistani health system for treatment, and the caseload reported by government facilities would rise. Between 1990 and 1997 62% of Refugee Programme BHU were closed down as 65% of the

not have access to the 71% of malaria in NWFP that was reported through the ARHP. The latter needs to be incorporated and evaluated before any assertion can be fairly levelled at refugees. Thus we have analysed the refugee malaria and population data in exactly the same way as Kazmi and Pandit (2001) did for Pakistani health service data in order to compare the two. We calculated malaria incidence per 1000 refugees (malaria cases/population \times 1000) for each district for each year and then converted these rates to standardised values as follows:

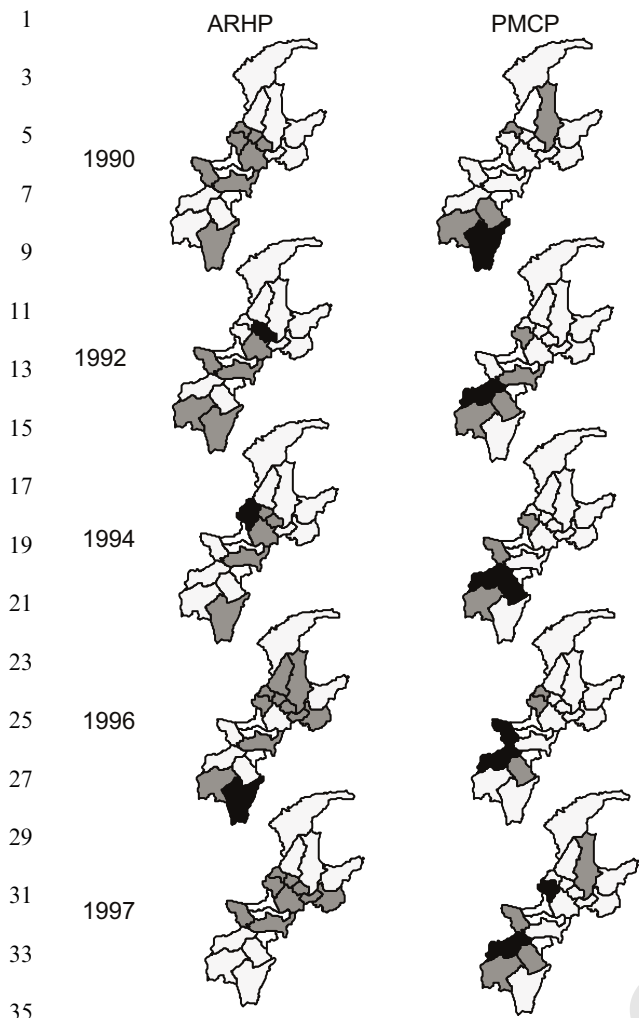


Fig. 6. Malaria incidence rates in districts and agencies of NWFP as recorded by the ARHP and the Pakistan National Malaria Control Programme. Incidence well above average ($Z \geq 1.5$), black shade; above average ($1.5 > Z > 0$), dark shade; below average ($Z \leq 0$), light shade; no data, white.

population repatriated to Afghanistan (Table 1). For the refugees of camps without BHU the average distance to an open BHU increased from 1 to 16 km (unpublished UNHCR Health Programme report). Faced with that problem, many Afghan refugees, being poor and unable to travel far (Christensen & Scott, 1988; Marsden, 1996), had little alternative but to turn to Pakistan government health services which were also available for free. Direct evidence for a shift in health service usage has been compiled by the provincial malaria control programme of Balochistan since 1996: 71% of malaria cases (34,921/49,484) in 1996 and 41% of malaria cases (10,719/26,319) in 1997 were of refugees accessing provincial

government health facilities. Most of the Pakistani population, on the other hand, continued to use the private sector (Donnelly, Konradsen, & Birley, 1997; PMRC, 1998), where they could obtain more effective drugs than the chloroquine that was provided through government outlets (N.B. owing to resistance, chloroquine fails to cure around 50% of *P. falciparum* infections in Pakistan (Shah et al., 1997; Rowland et al., 1997a b).

During the 1990s the majority of ARHP BHU closures (76%, 68/89) were in the westernmost districts and tribal areas (mostly UNHCR run), whereas only 49% (51/104) of closures were in the eastern districts (mostly NGO run). Thus the shift in health service utilization by refugees (from Refugee to Pakistan Health Programmes) was more marked in westernmost areas, and the westward shift in the distribution of malaria, as indicated in Kazmi & Pandit's analysis (and shown in Fig. 6), was an artifact due to regional differences in service provision. Malaria incidence in the westernmost areas (e.g. N. & S. Waziristan, Bannu) was traditionally low and that remained the case throughout the 1990s (see Table 1). Notwithstanding the changes in health seeking behaviour of refugees, there are three strands of evidence to indicate that malaria incidence truly declined in the refugee population between 1990 and 1997: the number of malaria cases recorded by ARHP fell from 81,608 to 26,856 (Fig. 5a), malaria incidence fell from 36 to 31 per 1000 population (Table 1) and malaria slide positivity rate fell from 23% to 16% (Fig. 5b).

These temporal trends and district-level analyses disguise the fact that malaria in Pakistan is a local phenomenon (among both refugee and Pakistani populations) mainly influenced by site geography. In each district could be found some camps with little or no transmission and some camps with significant transmission. For evidence of this note the range of incidence rates recorded in each district (Table 1) and for all refugee camp populations (Fig. 7). Presence or absence of transmission merely depended on whether mosquito breeding could be supported in or around the camp (Rowland, 1999). Some districts were plainly more malarious than others (Table 1), but when the ARHP and Pakistan health service data are examined side-by-side as in Fig. 6, there is no evidence for the spatial distribution of malaria having shifted between districts over the decade. Nor should malaria be seen as something irrevocable. As refugees gradually repatriate to Afghanistan and camps diminish in size, malaria too should diminish; and there is strong evidence that this is happening already (Table 1).

The ARHP was fortunate in the sense that international aid in the 1980s and early 1990s produced an above average health service which captured a significant proportion of actual morbidity in the refugee population. This has been corroborated by independent

Table 1
Afghan refugee health programme: summary of malaria and population records

| District | 1990 | | | | 1997 | | | | 1997:1990 | | |
|------------------------------------|-----------|------------|--------|------------------------|-----------|------------|--------|------------------------|---------------|------------------|-----------------|
| | No. BH-Us | Population | Cases | Incidence rate (range) | No. BH-Us | Population | Cases | Incidence rate (range) | % BH-U closed | Population ratio | Incidence ratio |
| Chitral | 6 | 50,434 | 89 | 2 (1, 46) | 0 | 12,462 | — | — | 100 | 0.25 | — |
| Bannu | 5 | 54,619 | 122 | 2 (1, 4) | 1 | 9600 | 5 | 1 — | 80 | 0.18 | 0.23 |
| N. Waziristan | 13 | 174,110 | 647 | 4 (1, 26) | 3 | 30,400 | 81 | 3 (2, 3) | 77 | 0.17 | 0.72 |
| S. Waziristan | 5 | 110,620 | 1794 | 16 (8, 55) | 2 | 40,800 | 929 | 23 (15, 67) | 60 | 0.37 | 1.40 |
| Abbottabad | 11 | 164,269 | 3853 | 23 (9, 43) | 7 | 104,580 | 4140 | 40 (3, 45) | 36 | 0.64 | 1.69 |
| Mansehra | 7 | 63,139 | 1525 | 24 (20, 28) | 6 | 30,608 | 114 | 4 (1, 5) | 14 | 0.48 | 0.15 |
| D I Khan | 10 | 85,816 | 2717 | 32 (8, 172) | 1 | 7800 | 108 | 14 — | 80 | 0.09 | 0.44 |
| Bajaur | 16 | 170,187 | 6215 | 37 (8, 139) | 4 | 32,000 | 925 | 29 (2, 50) | 75 | 0.19 | 0.79 |
| Kurram | 31 | 334,654 | 13,108 | 39 (3, 103) | 6 | 96,956 | 1890 | 19 (14, 48) | 81 | 0.29 | 0.50 |
| Kohat | 20 | 287,295 | 11,760 | 41 (8, 105) | 15 | 157,958 | 7172 | 45 (2, 140) | 25 | 0.55 | 1.11 |
| Mardan-Malakand-Swabi ^a | 16 | 211,884 | 9951 | 47 (7, 113) | 7 | 63,885 | 2331 | 36 (17, 57) | 53 | 0.30 | 0.78 |
| Peshawar | 45 | 558,407 | 29,827 | 53 (4, 381) | 18 | 283,532 | 9161 | 32 (12, 214) | 60 | 0.51 | 0.60 |
| Dir-Swat ^a | 8 | 77,562 | 4612 | 59 (13, 114) | 3 | 33,440 | 818 | 24 (13, 35) | 63 | 0.43 | 0.41 |
| Total | 185 | 2,265,434 | 81,608 | 36 (1, 381) | 71 | 870,581 | 26,856 | 31 (1, 214) | 62 | 0.35 | 0.74 |

^aManaged by single district health authority.

cross sectional malaria surveys that correspond with BHU outpatient statistics (Rowland et al., 1997a, 2001). The incidence of malaria being reported through the ARHP might therefore give a clearer picture of what is really happening within the rural Pakistani population with respect to malaria transmission rates. Our analysis of refugee data seems to support the notion that the national burden of malaria is probably several times greater than what is being reported through the public health sector. The national system of malaria reporting would clearly benefit from a more inclusive monitoring system that took into account a more representative range of treatment providers.

Our analysis also illustrates some of the pitfalls that can happen when interpreting or extrapolating from government health service data when there are other health systems operating in parallel. The oft paucity of government health statistics means they are readily open to misinterpretation. Whenever possible an independent means of corroboration should be found such as cross sectional parasite surveys or household surveys. Recent examples of the latter indicate that the majority of malaria in Pakistan is in fact treated through the private sector and goes unreported (Donnelly et al., 1997; PMRC, 1998).

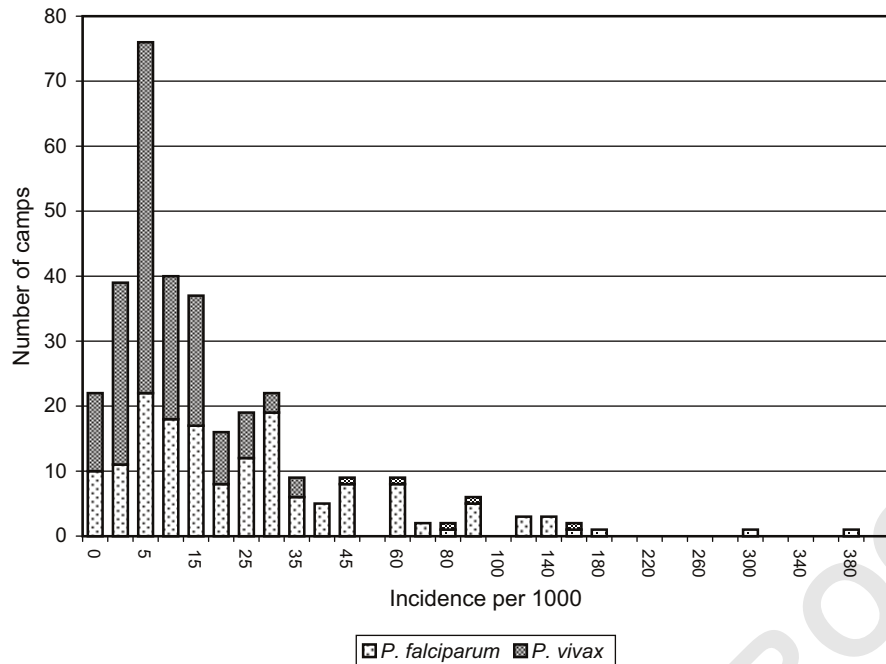


Fig. 7. The range of malaria incidence rates per annum by camp, presented as a frequency distribution. A minority of camps were highly malarious.

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References

- Boss, L. P., Brink, E. W., & Dondero, T. J. (1987). Infant mortality and childhood nutritional status among Afghan refugees in Pakistan. *International Journal of Epidemiology*, 16, 560–568.
- Bouma, M. J. (1996). Epidemiology and control of malaria in Northern Pakistan with special reference to Afghan refugees and the El-Nino southern oscillation. Unpublished Ph.D. thesis.
- Bouma, M. J., Dye, C., & van der Kaay, H. J. (1996a). Falciparum malaria and climate change in the North West Frontier Province of Pakistan. *American Journal of Tropical Medicine and Hygiene*, 55, 131–137.
- Bouma, M. J., Parvez, S. D., Nesbit, R., & Winkler, A. M. (1996b). Malaria control using permethrin applied to tents of nomadic Afghan refugees in northern Pakistan. *Bulletin of the World Health Organisation*, 74, 413–421.
- Buck, A. A., Anderson, R. I., Kawatta, K., Abrahams, I. W., Ward, R. A., & Sasaki, T. T. (1972). *Health and disease in rural Afghanistan*. Baltimore: York Press.
- Christensen, H., & Scott, W. (1988). *Survey of the social and economic conditions of Afghan refugees in Pakistan*. Geneva, Switzerland: United Nations Research Institute for Social Development.
- Donnelly, M. J., Konradsen, F., & Birley, M. H. (1997). Malaria-treatment-seeking behaviour in the southern Punjab, Pakistan. *Annals of Tropical Medicine and Parasitology*, 91, 665–667.
- Gill, C. A. (1938). *The seasonal periodicity of malaria and the mechanism of the epidemic wave*. London: Churchill.
- Girardet, E. (1998). An unending conflict. In E. Girardet, & J. Walter (Eds.), *Essential field guides to humanitarian and conflict zones: Afghanistan* (pp. 11–15). Geneva: Crosslines Communications.
- Kazmi, J. H., & Pandit, K. (2001). Disease and dislocation: The impact of refugee movements on the geography of malaria in NWFP, Pakistan. *Social Science and Medicine*, 52, 1043–1055.
- Khan, A. R., & Nesbitt, R. (1987). *Afghan refugee health programme annual report for 1986*. Pakistan: PanGraphics Ltd..
- Marsden, P. (1996). *Living in exile: Report on a study of economic coping strategies among Afghan refugees in Pakistan*. London: The Refugee Council.
- Marsden, P. (1998). Exile for a cause: The plight of refugees. In E. Girardet, & J. Walter (Eds.), *Essential field guides to humanitarian and conflict zones: Afghanistan* (pp. 40–47). Geneva: Crosslines Communications.

- 1 Mills, D., Rowland, M., Shah, I., Mujahid, C., Hyder, K.,
 3 Mackay, B., & Bari, F. (1998). *Review of the national
 malaria programme, Pakistan*. London: Malaria Consor-
 5 tum.
- 7 Najera, J. A. (1996). *Malaria control among refugees and
 displaced populations*. CTD/MAL/96.6. Geneva: WHO.
- 9 PMRC. (1998). Health survey of Pakistan: Health profile of the
 11 people of Pakistan. Islamabad, Pakistan: Pakistan Medical
 Research Council, 191pp.
- 13 Rowland, M. (1999). Malaria control: Bednets or spraying?
 Malaria control in the Afghan refugee camps of western
 15 Pakistan. *Transactions of the Royal Society of Tropical
 Medicine and Hygiene*, 93, 458–459.
- 17 Rowland, M., Durrani, N., Hewitt, S., & Sondorp, E. (1997a).
 Resistance of falciparum malaria to chloroquine and
 19 sulfadoxine-pyrimethamine in Afghan refugee settlements
 in western Pakistan: Surveys by the general health services
 21 using a simplified in vivo test. *Tropical Medicine and
 International Health*, 2, 1049–1056.
- Rowland, M., Hewitt, S., & Durrani, N. (1994). Malaria
 prevalence surveys in refugee camps sprayed with malathion
 and lambda-cyhalothrin. *Transactions of the Royal Society of
 Tropical Medicine and Hygiene*, 88, 378–379.
- Rowland, M., Hewitt, S., & Durrani, N. (1997b). Transmission
 and control of vivax malaria in Afghan refugee villages in
 23 Pakistan. *Transactions of the Royal Society of Tropical
 Medicine and Hygiene*, 91, 252–255. 25
- Shah, I., Rowland, M., Mehmood, P., Mujahid, C., Raziq,
 27 F., Hewitt, S., & Durrani, N. (1997). Chloroquine resistance
 in Pakistan and the upsurge of falciparum malaria in
 29 Pakistani and Afghan refugee populations. *Annals of
 Tropical Medicine and Parasitology*, 91, 591–602.
- Suleman, M. (1988). Malaria in Afghan refugees in Pakistan.
 31 *Transactions of the Royal Society of Tropical Medicine and
 Hygiene*, 82, 44–47.
- Toole, M. J., & Waldman, R. J. (1990). Prevention of excess
 33 mortality in refugee and displaced populations in develop-
 ing countries. *Journal of the American Medical Association*,
 35 263, 3296–3302.
- Zulueta, J. De. (1989). Malaria in Afghan refugees. Unpub-
 37 lished UNHCR report.
- Zulueta, J. De, Mujtaba, S. M., & Shah, I. H. (1980). Malaria
 39 control and long-term periodicity of the disease in Pakistan.
*Transactions of the Royal Society of Tropical Medicine and
 Hygiene*, 74, 624–632.

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