Some new environmental medical and virological aspects of HIV/AIDS

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The fourth session of the workshop was introduced by Linda McCourt-Scott, from the Department of Biological Sciences, University of Surrey, and the Department of Community Health, University of Stellenbosch. The presentation was entitled: “Is a deficiency of selenium exacerbating the HIV epidemic in South Africa?” McCourt-Scott introduced the workshop to new and potentially encouraging dimensions in research on the medical aspects of prevention, focusing on the role of one key micronutrient.

Selenium is an essential trace mineral required for immune function, antioxidant protection and thyroid hormone metabolism. The South African recommended daily allowance (RDA) for selenium is 55 mcg for adults, although there is some dispute over the sufficiency of this value. Dietary selenium intakes across the world range from high to low, depending on the levels and bioavailability of soil selenium in different geographical areas. Current intakes in the UK and much of Europe, for instance, are well below recommended levels, primarily because of low soil selenium bioavailability due to acid rain and other factors. In addition, many people rarely eat foods that are high in selenium (i.e. brazil nuts, kidney, liver, shellfish and fish) and are therefore mainly dependent on cereal crops as a source of selenium. However, selenium levels in plant foods vary widely depending on the amount and bioavailability of selenium in the soils in which they are grown. While animals require selenium to grow and reproduce, plants do not require this trace element and can therefore thrive in selenium-deficient soils.

There is a dearth of data on selenium levels in plants, animals and humans throughout Africa. The few studies that have been done, suggest that selenium deficiency in Africa appears in areas with higher rainfall and where the soils are predominantly acid and/or high in iron – all factors that reduce selenium bioavailability. These also represent the main areas in which crops will be grown. With regard to South Africa, extensive areas of selenium deficiency in grazing animals have been identified in kwaZulu-Natal, Gauteng, Mpumalanga and the Western Cape. One small study found that selenium deficiency appeared to be a problem among people living in the former Transkei and Ciskei. An analysis of cereal crops grown in South Africa has shown low selenium content and suggests that dietary intakes may therefore be generally low, especially among populations primarily dependent on plant foods.

Selenium is a critical nutrient in determining the course of HIV/AIDS because of its role in immune function and antioxidant protection. Research suggests that the HI-virus hijacks the host’s supply of selenium for its own antioxidant protection, thereby inducing or exacerbating a selenium deficiency with increasing disease progression. This has dire consequences as it has been conclusively demonstrated that selenium deficiency is associated with much faster disease progression in HIV-infected adults. In addition, selenium-deficient HIV-positive adults are 20 times more likely to die from HIV-related complications than those with adequate selenium status. Moreover, selenium deficiency confers a much greater mortality risk than deficiency of any other nutrient investigated. Recent research also suggests that selenium deficiency may increase the infectiousness of HIV-positive women. Selenium supplementation dramatically improves T-cell function and reduces apoptosis (cell death), and could therefore prove a valuable treatment adjunct in HIV/AIDS.
Selenium is required for the antioxidant enzyme glutathione peroxidase, a major protective enzyme against oxidative stress. Evidence suggests that HIV-1 infected patients are under chronic oxidative stress, which contributes to several aspects of HIV pathogenesis. A recent study demonstrated that selenium blood levels below 135mcg/L in HIV-infected drug users on antiretroviral therapy were associated with a three times increased risk of mycobacterial (tuberculosis) disease. Levels above 100mcg/L are considered adequate under normal conditions suggesting an increased need for selenium in HIV disease.

It has also been shown that relatively harmless RNA viruses quickly become virulent in a selenium-deficient host. The first crossing over of the HI-virus to humans occurred in the selenium-deficient population of Zaire/DRC, and other dangerous viruses have also emerged from this selenium-deficient area.

Human selenium deficiencies can be corrected through the addition of selenium to fertilisers, through food fortification, and by taking selenium supplements.

Nutrition as a whole, McCourt-Scott maintained, is a Cinderella aspect of medicine, but it represents an important treatment modality to help support immune function and delay the progress of HIV disease. This is especially relevant to the huge numbers of HIV-infected people living in sub-Saharan Africa who will never have access to antiretroviral therapy.

Selenium is important in prolonging the clinical latency stage of HIV/AIDS. Selenium deficiency can be both a cause and effect of disease progression. HIV-positive people with selenium deficiency encounter faster HIV progression and greater mortality, morbidity and infectiousness. It is therefore essential that the selenium status of populations throughout Africa, especially where the HIV/AIDS epidemic is raging, is urgently assessed and dealt with appropriately. Indeed, if the present indications of the research reported by McCourt-Scott are confirmed, selenium supplementation may be a highly cost-effective intervention, because it would strengthen the underpinnings of more general human security in circumstances where they are stressed already. The mechanism for this would be quite familiar in public health interventions. Improved resistance to initial infection abates the progression of the epidemic, longer clinical latency abates the socially destructive effects of premature deaths, and both these repair damage to the fabric of civil society. Furthermore, the net reduction in demand on the health budget alleviates the pressure to ignore or to downgrade other public health threats. Finally, a cheap and generalized intervention like selenium supplementation of fertilizers is the most equitable way to support the health status of even the very poorest individuals, since the action is not dependent upon treatment of individuals. Thus there can be a powerful reinforcement of social security. Together these actions relieve the pressures driving towards a traditional security crisis.

The workshop was excited by this work, and plans for accelerated field research in South Africa through collaboration by some participants was one of the practical outcomes arising from the meeting.

Dr Lynne Webber, Clinical Virologist for Lancet Laboratories and associate lecturer at the University of Pretoria and Medunsa, added a different but essential dimension in a riveting presentation that introduced the HI-virus as a (female) personality as a way of dramatising its remarkable ingenuity. This led to a discussion on immuno-biological genetics at the workshop.

This presentation served to raise one of the thorniest of the moral dilemmas about current medical responses to the virus. Because the demands of compliance with a treatment regime of antiretrovirals (ARV) are so severe, and the likelihood of patients being able to meet these unforgiving standards, so open to question, it must be frankly understood that “she” (the virus) might employ exposure to ARV like athletes use a training session: to familiarise “herself” with obstacles and to become stronger. Concerns were raised that the impending government antiretroviral treatment (ART) programme might most predictably produce a more drug-resistant virus. Nevertheless, this treatment rollout is currently the best that can be done about HIV/AIDS.
Once a person is on ART, the viral load does indeed recede, but in order to escape the ARVs, the virus already hiding in the genital tracts could follow the career of syphilis and retreat further to the eyes and brain. Recent studies have shown that, within days of HIV infection, “she” (the very capable and superbly designed virus) has already penetrated into the peripheral nervous system. What does this really mean? HIV “hides” away in the nervous system and uses this anatomical region as a “sanctuary site”. It also gives “her” easy and immediate access to the central nervous system (the spinal cord, brain and eyes) where she can lie virologically dormant or evoke physiological and immunological mischief. In short, the ARV rollout programme has both self-evident short-term benefits and potential long-term adverse consequences. Epidemiologically, the best single medical intervention in South Africa is the prevention of mother-to-child transmission.

The second most effective medical intervention would be one that empowered women to protect themselves from infection during sex without the man’s knowledge and in the absence of (or refusal to use) barrier contraception. Viricidal pessaries and creams – even, from some recent Australian research, as simple as the presence of lemon juice in the vagina – could be beneficial in combating a disease which, for mechanical reasons, is one that infects women more often than men.

The development of a vaccine capable of entering and destroying the “power house” of the virus remains a tremendous challenge. The problem lies in the sophistication of the virus’s chameleon-like ability to change its protein coatings with extraordinary frequency, thereby frustrating the ability of vaccines to recognize the target. It is doubtful whether even a concept for the design of a core vaccine is yet identified. However, French advances in developing vaccines that can activate the guardian functions of mucosa were more promising.

These observations led to a vigorous discussion of the social construction of sexuality. It was evident that the employment of the various pharmacological female defence options were predicated upon an assumption of failure to control or curb male sexual demands for unprotected sex (demands painfully documented in Campbell’s field work from Summertown, Letting them Die). It all raised a bleak picture of the state of war between the sexes if it was so difficult – even impossible – for the terms of sexual intercourse to be negotiated. Yet, this appears to be the state of affairs in many places. The exceptions thus become vitally important cases for close study – an issue that was returned to in the final session.

Webber made it perfectly clear that, in the human timescale, the HI-virus will never go away. The virus comes from an ancient (millions of years old) viral family: those retroviruses that have actually evolved along with the development of the cell itself. Retroviruses are thus ubiquitous and humans even have endogenous retroviral “footprints” integrated into their own DNA genome. Does HIV understand mankind’s own immune response and the only defence against viral destruction superbly and will she always have the “upper hand” in her attempts to evade the immune response? Treatment is currently the best option against the virus, and potent new drugs and technologies are constantly becoming available. Yet, intervention cannot stop at treatment alone: the preventive message has to be stronger.

Webber posed a further problem: “why has HIV-infection, in all its aspects, become different from any other viral infection?” She illustrated this dilemma by using examples of other viral infections to illustrate that HIV, in the discipline of Medical Virology, is really not unique and shares many of “her” features with other viral infections. A few examples were given to drive home the message. No human herpes viral infections can be “cured” and these infections stay with the host for life. Certain slow acting neurodegenerative viral infections also have long incubation periods, possibly taking years to kill or damage the host. The hepatitis B virus (HBV) is a sexually transmitted, as well as a bloodborne infection and 10% of individuals become permanent viral disease carriers. Interestingly, HBV also has the reverse transcriptase enzyme, which indicates that this enzyme is not a unique strategy of HIV alone.

One of the participants in the workshop reflected on the reasons why HIV/AIDS has come to be treated in a different way from any other disease. HIV, the participant maintained, first appeared in
homosexual communities in the 1980s, and thus from the very outset the disease was politicized. In effect, with HIV/AIDS, the period of death is deferred long enough to permit considerable further transmission, but short enough to impact significantly on the social structures of a society and a household. It is the length of time from incubation to morbidity to death that is decisive with HIV/AIDS. It is a disease that hits two reproductive and one generational group, and there is thus resonance between the natural cycle of the virus and the natural cycle of society.