Needs of Training in Infection-Associated Cancer in Mali

Besoins en Formation sur les Cancers Associés aux Infections au Mali.

Maiga M[1,2], Kassogué Y[1,3], Diakité B[1,3], Somboro AM[1,2]

1 Centre de Recherche et de Formation sur les Pathologies Moléculaires (CREFPAM), University Teaching Hospital of Point G, Bamako, Mali.

2 Faculty of Pharmacy, University of Sciences, Techniques and Technologies of Bamako (USTTB), Bamako, Mali.

3 Faculty of Medicine and Odontostomatology, University of Sciences, Techniques and Technologies of Bamako (USTTB), Bamako, Mali.

*__Auteur correspondant :__ Dr Mamoudou Maiga, University of Sciences, Techniques and Technologies of Bamako (USTTB), Bamako, Mali; Phone: +223-70 02 58 02, email: mamoudou.maiga@gmail.com

ABSTRACT

Infection-associated cancers (IAC) pose a significant public health threat in low- and middle-income countries (LMICs) such as Mali, where infection rates are high. IACs account for more than a quarter (27%) of all cancers in Mali. However, the limited training opportunities for students, faculty, researchers, and professionals hamper the research needed to develop new strategies to address the current epidemiological trends. The Research and Training Centre in Molecular Pathology "Centre de Recherche et Formation sur les Pathologies Moléculaires" (CREFPAM), in collaboration with its international partners in the United States, aims to bridge this gap. They propose a combination of short-, medium-, and long-term training programs to equip the next generation of researchers with the skills needed to effectively tackle this emerging threa. This unique program should have a lasting, long-term impact on the control and management of these cancers in LMICs.

Keywords : Training, Cancer, Mali

RESUME

Les cancers associés aux infections (CAI) constituent une menace importante pour la santé publique dans les pays à revenu faible et intermédiaire (PRFI) comme le Mali, où les taux d'infection sont très élevés. Les CAI représentent plus d'un quart (27%) de tous les cancers au Mali. Cependant, les possibilités limitées de formation pour les étudiants, les professeurs, les chercheurs et les professionnels entravent la recherche nécessaire au développement de nouvelles stratégies pour faire face aux tendances épidémiologiques actuelles. Le Centre de Recherche et Formation sur les Pathologies Moléculaires (CREFPAM), en collaboration avec ses partenaires internationaux aux États-Unis, vise à combler cette lacune. Il propose une combinaison de programmes de formation à court, moyen et long terme afin de doter la prochaine génération de chercheurs des compétences nécessaires pour s'attaquer efficacement à cette menace émergente. Ce programme unique devrait avoir un impact durable et à long terme sur le contrôle et la gestion de ces cancers dans les PRFI.

Mots-clés : Formation, Cancers, Mali

BACKGROUND

In 2022 alone, the global burden of cancer was staggering, with nearly 20 million new cases diagnosed and approximately 9.7 million deaths attributed to cancer [1]. An estimated 15.4% of these cases are attributable to infection-associated cancers (IACs) [2]. Infectious carcinogens cause a disproportionate burden of cancers in Africa compared to high-income countries, with two-thirds of these IACs occurring in low- and middle-income countries (LMICs), where infectious diseases remain a top public health problem [2, 3] Common viral and bacterial pathogens known to cause cancer include [4] :

- Hepatitis B virus (HBV) and Hepatitis C virus (HCV) in hepatocellular cancer (HCC)
- Human papillomavirus (HPV) in cervical cancer
- Epstein-Barr virus (EBV) in lymphoma
- Human herpes virus 8 (HHV-8) in Kaposi's sarcoma
- Helicobacter pylori (HP) in stomach cancer
- Mycobacterium tuberculosis (MTB) in lung cancer
- Schistosoma haematobium in bladder cancer

One of the most common virally-induced cancers in West Africa is cervical cancer, which is entirely attributable to sexually transmitted HPV infection [4]. HCC is another highly prevalent virus-associated cancer in Africa [5]. In sub-Saharan Africa (SSA), HBV is endemic, with an estimated lifetime risk of infection of 60%, and over 8% of the population in high-risk chronic carrier state will progress to HCC [5]. The introduction of antiretroviral therapies has certainly improved patients' quality of life. However, it is worth remembering that some patients, due to unstable immunity, are prone to co-infections and subsequent cancer [6].

Among the five most common cancers in West African countries, including Mali, four (lung, stomach, liver, and cervical/uterine cancer) are associated with infections [7]. These four cancers are significant contributors to cancer cases worldwide and are among the most prevalent cancers in Mali [7, 8] . In 2018, these four IACs represented more than a quarter (27%) of all cancers in Mali [9]. The infections linked to these cancers, including HBV, HP, HPV, and MTB, are highly prevalent in Mali. Mali-specific data from GLOBOCAN [10] reported the following incidence and mortality rates for these infections:

- Lung cancer: Incidence rate of 1.9% and mortality rate of 2.6%
- Gastric cancer: Incidence rate of 8.3% and mortality rate of 10.9%
- Liver cancer: Incidence rate of 4.6% and mortality rate of 5.7%
- Cervical/uterine cancer: Incidence rate of 16.8% and mortality rate of 17.7%

The reports on IACs data from LMICs, including Mali, likely substantially underrepresent the actual number of cases due to the lack of access to healthcare, cancer registries, screening, and diagnostic testing. Mali currently does not have a national system for cancer registry and surveillance, and there are only a few scientists with the necessary skills and training to conduct large-scale studies to understand the epidemiology and identify at-risk individuals. As a result, there is limited information available to develop effective strategies for cancer prevention and control.

Epidemiological data, including molecular epidemiology data generated from large population-based studies, will provide crucial information for developing strategies for risk stratification, population-level screening, and prevention of IACs in countries with high rates of these infections, such as Mali. The Malian population is highly heterogeneous, with over 20 different ethnic groups representing the broader West African population. This diversity offers a unique opportunity for extensive analysis of West African genetic biomarkers for IACs. Moreover, infections and other risk factors can induce epigenetic alterations that contribute to the development of IACs. Understanding the interactions between predisposing infections, genetic variants, and subsequent gene/environment interactions will enable the identification of at-risk individuals for more effective and targeted screening, early detection, and intervention approaches, ultimately advancing cancer prevention strategies.

Establishing a Research and Training Program to address the high-priority research needs is imperative. Such a program will create a well-trained, interdisciplinary, and collaborative team of experts equipped to conduct large-scale population-based cancer research. The program should include short-, medium-, and long-term training components to cover the most needed areas. This comprehensive approach ensures the development of a robust and sustainable research infrastructure capable of effectively addressing critical cancer research challenges and improving public health outcomes. By investing in research and training, Mali will foster innovation, enhance scientific capacity, and contribute to the development of strategies for cancer prevention and control.

THE CURRENT ONGOING CANCER TRAINING PROGRAM IN MALI

The D43 program between Northwestern University (NU) and Mali's University of Sciences, Techniques and Technologies of Bamako "Université des Sciences, des Techniques, et des Technologies de Bamako" (USTTB), led by Drs. Lifang Hou and Mamoudou Maiga has successfully reached its halfway point, with many notable achievements:

- Annual Symposia: Three Annual Symposia were held at USTTB in Bamako, Mali. These events featured participation from investigators at NU, the University of Chicago, Harvard Medical School, Jos University in Nigeria, and Université Joseph Ki Zerbo in Burkina Faso. Presentations covered program updates, available training opportunities, and discussions on various types of cancers (cervical, oral, liver, stomach, lung, and colon)

in Mali. Topics included genetic and epigenetic aspects, molecular microbiology, implementation strategies, new assay development, the Weekend 70 Project on cervical cancer screening in Mali, mentoring workshops, the newly established Master's program in Genetics and Molecular Pathology, and the role of telepathology in cancer research and training.

• Creation of CREFPAM: The Research and Training Center for Molecular Pathology (CREFPAM) was established in 2019 at USTTB. This center is a result of NU's investments in cancer research since 2016, including this D43 funding. CREFPAM was visited by the Malian Ministry of Health and the Ministry of Higher Education and Research in December 2022 and March 2023. The center is recognized for its significant role in combating cancer in Mali and other developing countries.

• New Master's Program: A new Master's program in Genetics and Molecular Pathology was launched at USTTB, sponsored by the D43 program. The program provides full support for six candidates. The first cohort, comprising 10 students, began in March 2024.

• PhD Trainees: Five PhD trainees at USTTB's Doctoral School have been recruited and are receiving funding and training from the project. Their research topics include:

- Genetics and epigenetics of cervical cancer
- Helicobacter pylori in stomach and liver cancer
- Epidemiology of Human papillomavirus (HPV) strains in Mali
- Microbiome role in colorectal cancer in Mali
- Development of a Smart Microscope for telepathology and breast cancer diagnosis in rural Mali
- Master's Sponsorship: A total of 11 Master's students are being sponsored, including:
- Six in Genetics and Molecular Pathology at USTTB, Mali
- Two in Epidemiology at USTTB, Mali
- Two in Biostatistics at Université Joseph Ki Zerbo (UJKZ), Burkina Faso
- One in Bioinformatics at USTTB, Mali

These efforts are making substantial contributions to the research and management of IAC in Mali, establishing a strong foundation for future advancements in public health.

In addition, the private sectors are also involved in cancer research through public-private partnerships, bringing together the resources, expertise, and perspectives of different entities to solve cancer-related problems. Our research team (CREFPAM) in Mali has established a strong and fruitful partnership between local associations and non-governmental organizations such as the 'Wale' centre in Segou, Mali, and the "centre for care, support, and advice for people with HIV/AIDS (CESAC) to develop strategies for the early diagnosis and prevention of cancer in high-risk populations and to introduce targeted therapies and immunotherapy treatments.

CONCLUSION

A long-term outcome of this program will be the establishment of a sustainable and strong network of well-trained next generation researchers and professionals in Mali focused on the research and care of IACs. This innovative model of research training is pioneering for Mali and has significant implications for advancing public health, not only in Mali but also across Africa and potentially in other low- and middle-income countries worldwide.

Conflict of Interests: The authors declare no conflict of interests.

Funding : This work was funded by the USA National Cancer Institute through grants D43CA260658 and U01CA275129.

Authors' Contributions : MM, YK, BD and AMS designed, wrote the manuscript and critically revised the article. All authors approved the final version submitted for publication.

REFERENCE

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229-63.

2. Plummer M, de Martel C, Vignat J, Ferlay J, Bray F, Franceschi S. Global burden of cancers attributable to infections in 2012: a synthetic analysis. Lancet Glob Health. 2016;4(9):e609-16.

3. Omotoso O, Teibo JO, Atiba FA, Oladimeji T, Paimo OK, Ataya FS, et al. Addressing cancer care inequities in sub-Saharan Africa: current challenges and proposed solutions. Int J Equity Health. 2023;22(1):189.
4. de Martel C, Georges D, Bray F, Ferlay J, Clifford GM. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. Lancet Glob Health. 2020;8(2):e180-e90.
5. Parkin DM, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. CA Cancer J Clin. 2005;55(2):74-108.
6. Borges Á H. Combination antiretroviral therapy and cancer risk. Curr Opin HIV AIDS. 2017;12(1):12-9.
7. Hamdi Y, Abdeljaoued-Tej I, Zatchi AA, Abdelhak S, Boubaker S, Brown JS, et al. Cancer in Africa: The Untold Story. Front Oncol. 2021;11:650117.
8. Diakite M, Shaw-Saliba K, Lau CY. Malignancy and viral infections in Sub-Saharan Africa: A review. Front Virol. 2023;3.
9. UICC. Cancer in Sub-Saharan Africa. Union for International Cancer Control. 2019.
10. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68(6):394-424