

Alcohol and Cancer Burden In Uganda, Challenges, & Recommendations



Dr Alfred Jatho (PhD)
Community Cancer Health Educator | Cancer Prevention &
Early Detection Specialist
HoD Community Cancer Services
Uganda Cancer Institute

Alcohol and Health risk:

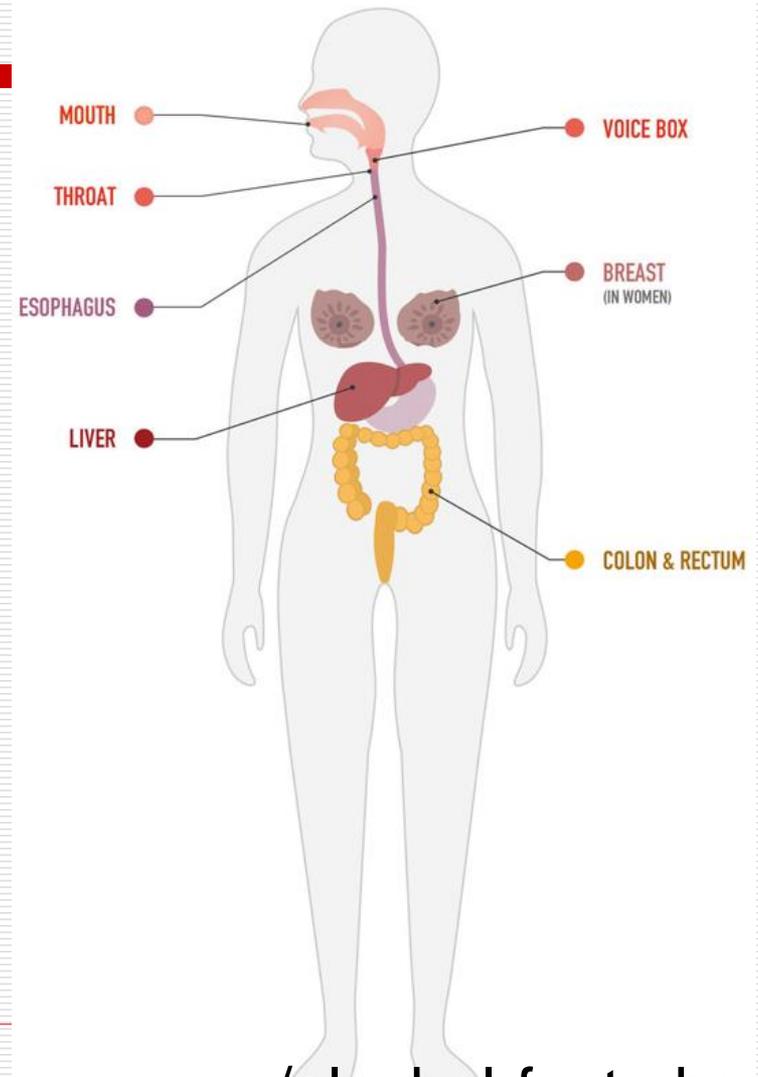
- ❑ In 2019, Uganda ranked the eight-leading country in the world, with 12.48 liters of pure alcohol per capita.
 - ❑ Alcohol consumption has been linked to more than 200 diseases and injury conditions, including, infectious diseases, cirrhosis, cancer, cardiovascular disease, early dementia and mental disorders.
-

Alcohol and Cancer risk: Evaluation of Human Carcinogens by IARC

Group	Example
Group 1	Formaldehyde, Benzo[a]pyrene, Alcoholic beverages , Benzene, Asbestos, Outdoor air pollution, Processed meat, Solar radiation, Tobacco use, Welding fumes, Wood dust, oncogenic infections such HPV, HBV, HCV, etc
Group 2A	DDT, Acrylamide, Glyphosate
Group 2B	Vinyl acetate, Pyridine, Lead, Digoxin
Group 3	Ampicillin, Ethylene, Fluorene, Coal dust, Coffee, drinking, Dental materials, Fluorescent lighting, Electric fields, Hepatitis D virus, Hair colouring products (personal use of), Human papillomavirus types 6 and 11, Paint manufacture (occupational exposure in), Silicone breast implants, Printing inks

What is the evidence that alcohol drinking can cause cancer?

- Alcohol consumption causes cancers of the oral cavity, pharynx, larynx, oesophagus, colorectum, liver and female breast (IARC, 2012) and
- possibly cancer of the stomach, pancreas, lung, and gallbladder (Cao et al. 2015).
- **Alcohol** consumption is carcinogenic to humans (Group 1).



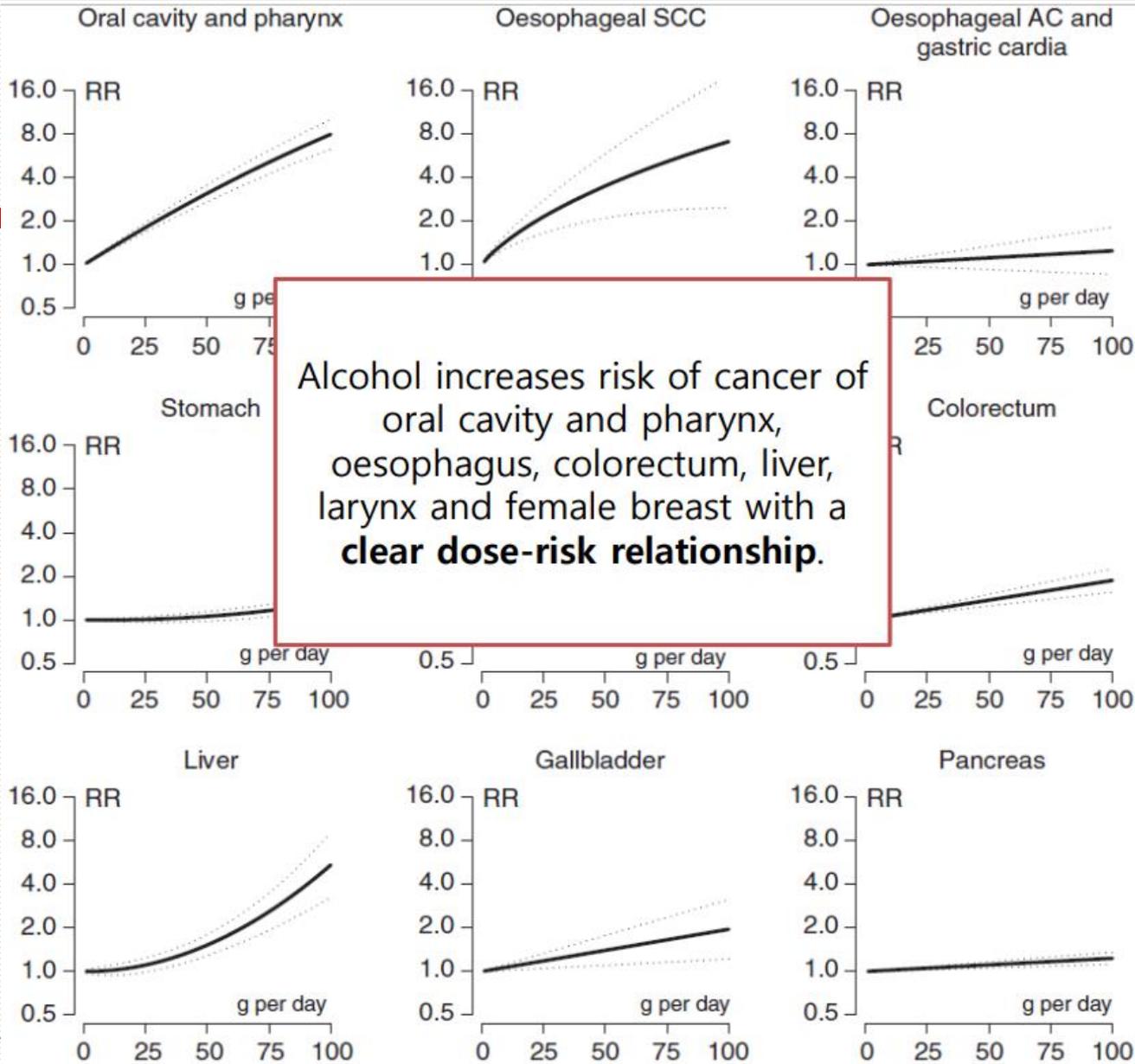
Contributions of Risk Factors to All Cancer Mortality

Risk factor	PAF (%)		
	Worldwide	LMICs	HICs
Smoking	21	18	29
Alcohol	5	5	4
Low fruit and vegetable intake	5	6	3
Overweight/obesity	2	1	3
Physical inactivity	2	2	2
Contaminated injection	2	2	<0.5
Unsafe sex	3	4	1
Air pollution	1	1	1
Indoor smoke from solid fuels	<0.5	<0.5	0

Alcohol and Cancer risk

- ❑ Alcohol consumption accounts for about 3% and 10% of total cancers diagnosed in women and men, respectively.
 - ❑ In both genders, the alcohol-attributable fraction is high for upper aero-digestive tract; lips, mouth, tongue, nose, throat, esophagus and trachea (25–44%), liver (18–33%), and colorectal (4–17%) cancers, and in women for breast cancer (about 5%) (Scoccianti et al. 2015).
 - ❑ In liver cancer, for example, alcohol increases HCC risk at least twofold; some studies suggest at least a fivefold increase (Lafaro, Demirjian & Pawlik 2015)
-

Alcohol and Cancer risk



How does alcohol cause cancer?

1. Acetaldehyde

- ❑ When we drink alcohol (ethanol in an alcoholic beverage), it is turned in to a chemical called acetaldehyde.
 - ❑ Acetaldehyde is a genotoxic (can damage the DNA/ genetic information within a cell) metabolite of ethanol.
 - ❑ This happens mainly in the liver.
 - ❑ Acetaldehyde can cause cancer by damaging DNA and stopping our cells from repairing this damage.
 - ❑ The carcinogenicity of alcoholic beverages does NOT seem to vary with the type of beverage; the effect appears to be caused by ethanol itself (Scoccianti et al. 2015)
-

How does alcohol cause cancer?

2. Hormone changes

- ❑ Hormones act as messengers in the body, giving our cells instructions - including when to grow and divide.
 - ❑ Alcohol can increase the blood levels of some hormones such as oestrogen and insulin.
 - ❑ Oestrogen, a sex hormone, is linked to the risk of breast cancer.
-

How does alcohol cause cancer?

3. Increased absorption of other carcinogens

- Alcohol can affect the cells between the mouth and throat, which may make it easier for other carcinogens to be absorbed.
-

How does alcohol cause cancer?

4. Impairing absorption of a variety of nutrients

- ❑ Alcohol impairs the body's ability to break down and absorb a variety of nutrients that may be associated with cancer risk.
 - ❑ Notably, vitamin A; nutrients in the vitamin B complex, such as **folate**; vitamin C; vitamin D; vitamin E; and carotenoids.
-

How does alcohol cause cancer?

5. Mitochondrial injury

- ❑ Ethanol potentiates mitochondrial injury by further increasing reactive oxygen species (ROS) production and enhancing oxidation, ex. hepatic glutathione oxidation.
 - ❑ ROS are chemically reactive molecules that contain oxygen.
 - ❑ ROS can damage DNA, proteins, and lipids (fats) in the body through a process called oxidation
 - ❑ Thus, resulting in increased apoptosis and cell injury (Singal & Anand 2007)
-

How does alcohol cause cancer?

6. Carcinogenic contaminants

- ❑ Alcoholic beverages may also contain a variety of carcinogenic contaminants that are introduced during fermentation and production, such as:
 - ❑ Nitrosamines,
 - ❑ Asbestos fibers,
 - ❑ Phenols, and
 - ❑ Hydrocarbons.
-

The levels of metals ($\mu\text{g/L}$) in each brand of alcohol and their associated health indices (HI). HI is listed from the most significant (top) to the least (bottom).

Sachet brand	Metal content ^a	HI metals	Ratio ^b
Ethanol	—	4.1 (1.0) ^c	>1 (1) ^c
TEB	12143 ^d	7.3x10 ^{-2 e}	1/14
AWE	4342 ^d	2.6x10 ^{-2 e}	1/38
REX	794.5	1.3x10 ⁻²	1/83
NSB	1479 ^d	1.1x10 ^{-2 e}	1/91
BOL	1340 ^d	9.6x10 ^{-3 e}	1/104
TGL	538.0 ^d	5.7x10 ^{-3 e}	1/192
B5V	200.8	1.9x10 ⁻³	1/529
B7W	64.8	1.5x10 ⁻³	1/714
BEG	148.4	1.3x10 ⁻³	1/769
GOV	123.3	1.1x10 ⁻³	1/909
KPW	166.5	1.1x10 ⁻³	1/1000
BRG	123.3	8.9x10 ⁻⁴	1/1136
CW1	43.3	8.7x10 ⁻⁴	1/1176
ROV	164.1	8.3x10 ⁻⁴	1/1266
CW2	113.6	7.8x10 ⁻⁴	1/1300
SAG	138.9	6.9x10 ⁻⁴	1/1493
UGW	16.1	6.3x10 ⁻⁴	1/1639
V6T	148.5	5.8x10 ⁻⁴	1/1818

The 13 brands were Big 5
Vodka (B5V),
Beckham Spirit (BEG), Bond 7 Whisky (B7W),
Brigade Spirit (BRG), Chief Waragi Spirit (CW1 and CW2, duplicates sampled one year apart), Goal Vodka (GOV), Kick Spirit Pineapple Waragi (KPW), Relax (REX), Royal Vodka (ROV), Salongo Spirit (SAG), Uganda Waragi (UGW), and V6 Tangawizi Vodka (V6T).

How does alcohol cause cancer?

7. Synergistic mechanism

- ❑ Research shows that people who use both alcohol and tobacco have higher risks of developing cancers of the oral cavity, pharynx (throat), larynx, and esophagus than people who use either alcohol or tobacco alone.
- ❑ For oral and pharyngeal cancers, the risks associated with using both alcohol and tobacco are multiplicative; that is, they are greater than would be expected from adding the individual risks associated with alcohol and tobacco together (Turati et al. 2013, Hashibe et al. 2009).
- ❑ Synergistic mechanism has also been observed with HBV and HCV.
- ❑ EX. greater HCV replication in the presence of alcohol, increased oxidative stress & inhibition of hepatic expression of Bcl-2 (Singal & Anand 2007)

How does alcohol cause cancer?

8. Increased risk of sexually transmitted cancer-causing infections

- ❑ Alcohol consumption is linked to infectious diseases such as HIV in Uganda (Kim et al. 2016, Zablotska et al. 2006).
 - ❑ Alcohol impairs judgment and may influence the risk of sexually transmitted oncogenic infections such as HPV (risk factor for cervical, anal, penile and head and neck cancers), HBV and HCV (risk factor for liver cancer), HIV (risk factor and co-factor for several cancers such cervical cancer, KS, and certain types of lymphoma), and HHV-8 (risk factor of KS).
 - ❑ The infection-associated cancers such as cervical, KS, liver, lymphoma, and penile cancers are among the top 10 cancers in Uganda.
-

What happens to cancer risk after a person stops drinking alcohol?

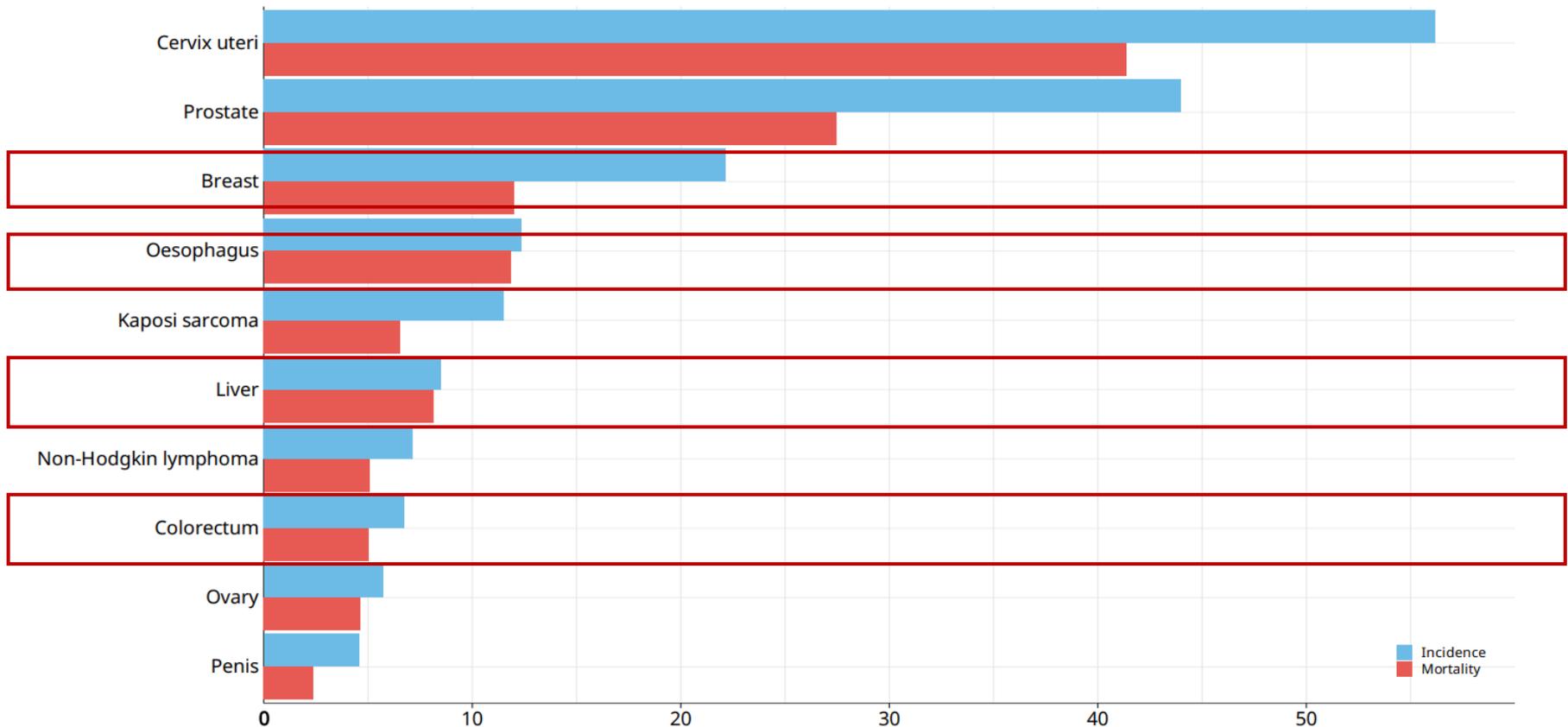
- ❑ Stopping alcohol consumption is not associated with immediate reductions in cancer risk.
 - ❑ The cancer risks eventually decline, although it may take years for the risks of cancer to return to those of never drinkers.
 - ❑ This was demonstrated in study on head and neck cancers and on esophageal cancer.
-

What happens to cancer risk after a person stops drinking alcohol?

- For example, ex-drinkers still had higher risks of oral cavity and pharyngeal cancers than never drinkers even 16 years after they stopped drinking alcohol, although it was lower than before they stopped drinking (Rehm et al. 2007).
 - One study estimated that it would take more than 35 years for the higher risks of laryngeal and pharyngeal cancers associated with alcohol consumption to decrease to the level of never drinkers (Ahmad Kiadaliri et al. 2013).
-

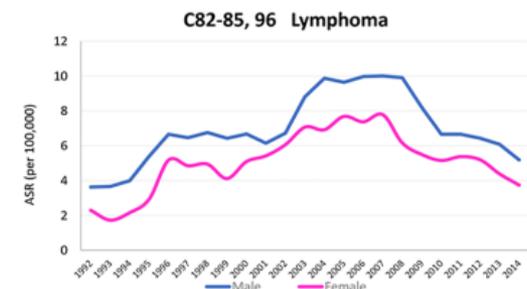
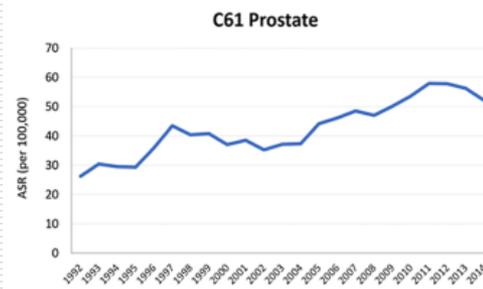
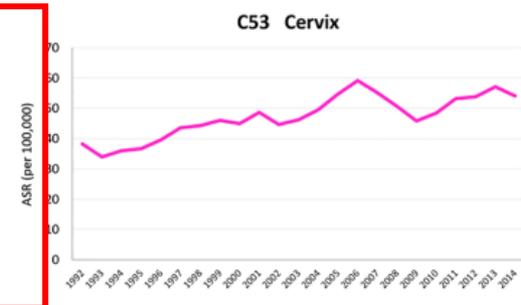
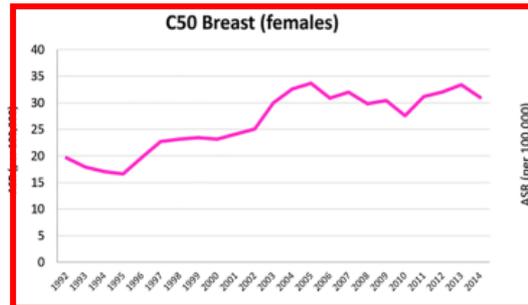
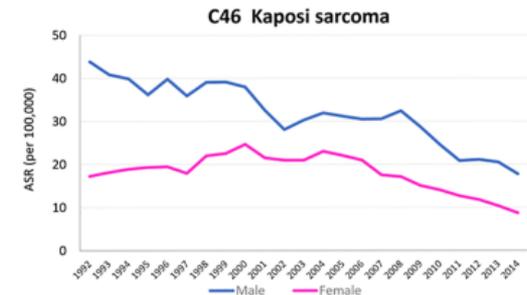
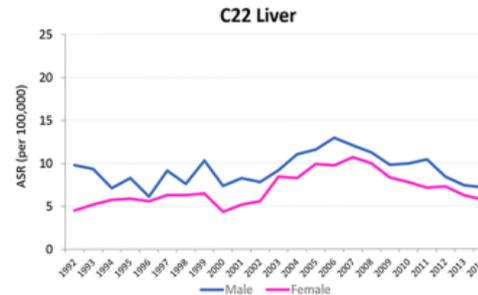
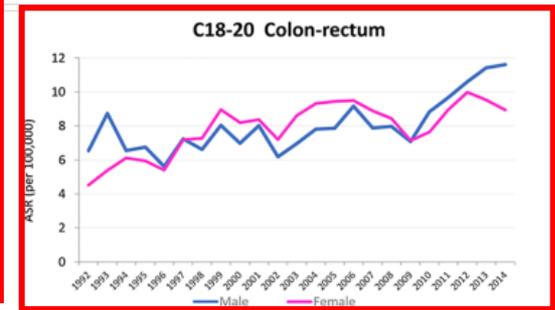
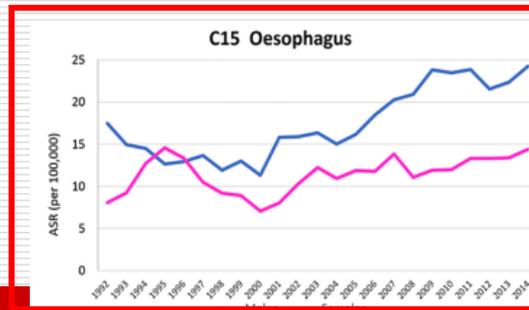
The Burden of Alcohol Associated Cancers In Uganda

Estimated age-standardized incidence and mortality rates (World) in 2020, Uganda, both sexes, all ages (excl. NMSC)



Trends of the most common Cancers in Uganda:

Trends in age-standardized incidence rates per 100,000 (3-year moving averages) Vs other cancers-
KPBCR
(Bukirwa et al 2020)



The Burden of Alcohol Associated Cancers In Uganda

Study	Aim(s) / Focus	Design / method	Findings
Okello et al. 2016	Population attributable fraction (PAF) of Esophageal squamous cell carcinoma due to smoking and alcohol in Uganda	Case-control study	PAF of ESCC due to smoking, alcohol intake and a combination of alcohol & smoking were 16, 10 , and 13 % respectively.
Boffetta Et al. 2006	The burden of cancer attributable to alcohol drinking, Worldwide, including Africa, Uganda included in the sample of surveys conducted in 69 countries.	Data from meta- and pooled analyses and from the WHO Global Burden of Disease survey.	PAF of 6.5% in men and 2 % in women in East and central Africa for of cancers of the oral cavity, pharynx, esophagus, liver, colon, rectum, larynx and female breast.

The Burden of Alcohol Associated Cancers In Uganda

Study	Aim(s) / Focus and Scope	Design / method	Findings
Okello et al. 2015	Risk Factors of Esophageal Squamous Cell Cancer in Southwestern Uganda.	Case-Control Study.	History of both alcohol and smoking were associated with ESCC (AOR 4.10 , 95%CI 1.14 - 14.78).
Okello et al. 2023	Dietary Heterocyclic Amine Intake and Risk of Esophageal Squamous Cell Carcinoma in Rural Uganda	Case-Control Study.	Drinking 3 to 4 alcoholic drinks daily was associated with ESCC (AOR 8.00 , 95% CI 2.31 - 27.74)

The Burden of Alcohol Associated Cancers In Uganda

Study	Aim(s) / Focus and Scope	Design / method	Findings
Qian et al. 2014	Alcohol Consumption and Breast Cancer Risk among Women in Three Sub-Saharan African Countries. Uganda inclusive.	Case-Control Study	In all the study sites (Uganda, Nigeria, and Cameroon), both past (AOR = 1.54 ; 95% CI: 1.19–2.00) and current drinking (AOR = 1.71 ; 95% CI: 1.30–2.23) were associated with breast cancer risk. However, Uganda alone, exhibited statistically insignificant association.

The Burden of Alcohol Associated Cancers In Uganda

Study	Aim(s) / Focus and Scope	Design / method	Findings
Rukundo et al. 2014	The association between red blood folate levels and breast cancer among women seen at a tertiary Ugandan hospital.	Case-Control Study	Alcohol drinking was associated with breast cancer risk (2.1 (1.1-4.1)). The odds of having breast cancer among women with normal folate levels compared to those with low folate levels were 1.4 (95% CI 0.7 to 2.9)
Wekha et al. 2021	Prevalence and factors associated with CRC among patients hospitalized with lower gastrointestinal complaints at a tertiary health facility in Uganda.	10-year retrospective chart review	Alcohol consumption, smoking, diet, and family history of malignancies, combined as any risk factor of CRC, was associated with the CRC risk (AOR: 5.3 (2.9–9.9)).

The Burden of Alcohol Associated Cancers In Uganda

Study	Aim(s) / Focus and Scope	Design / method	Findings
Olasubomi et al. 2022	association between benign breast disease (BBD) and breast cancer (BC) in a heterogeneous population of African women: Nigeria Cameroon, and Uganda.	Case-Control Study between 1998–2018	Alcohol consumption mediated BBD and BC risk by 3.3 % with total mediation effect of (AOR: 1.508 (1.204–1.889)*)
Otim, Juma, and Otunnu. 2019	Investigation into the link between 'sachet' alcohol intake and health risk in Uganda , Acholi Sub-region – assessed the health risk associated with consuming heavy metal contaminated alcoholic products	A cross-sectional study based on the US Environmental Protection Agency (US EPA)	A strong correlation was observed between ingestion of spirits and health risks and in. At >2.5 sachets/day for 240 day/year over a lifetime for example, the risk of developing cancer due to exposure to As, Pb and Cr alone is 1 in 102,041 .

Recommended public policy strategies for alcohol control at national level

- ❑ **The WHO 2010 global strategy on harmful use of alcohol supports ten target areas for national actions:**
 - ❑ Leadership, awareness and commitment;
 - ❑ Health services' response;
 - ❑ Community action;
 - ❑ Drink-driving policies and countermeasures;
 - ❑ Availability of alcohol;
 - ❑ Marketing of alcoholic beverages;
 - ❑ Pricing policies;
 - ❑ Reducing the negative consequences of drinking and alcohol intoxication;
 - ❑ Reducing the public health impact of illicit alcohol and informally produced alcohol;
 - ❑ Monitoring and surveillance.
-

The three best public policy and prevention interventions at national level

- ❑ WHO recently identified the three best interventions to tackle harmful alcohol use at national level.
 - ❑ Restricted access to retailed alcohol
 - ❑ Limitation of alcohol advertising, and
 - ❑ Taxes on alcohol.
-

What mechanisms are present to monitor alcohol consumption in Uganda?

- WHO Stepwise Approach to Surveillance (STEPS): Uganda STEPS Survey of Non-communicable Disease (NCD) Risk Factors-2014. Participants = 3987 adults

Results for adults aged 18-69 years (incl. 95% CI)	Both Sexes	Males	Females
% currently drink (drank alcohol in the past 30 days)	28.5 (26.2-30.8)	40.1 (36.5-43.6)	17.9 (15.3-20.5)
% engage in heavy episodic drinking (6 or more drinks on any occasion in the past 30 days)	16.7 (14.9-18.5)	26.2 (23.1-29.4)	7.9 (6.3-9.6)
% past 12 month abstainers	12.1 (10.8-13.4)	12.5 (10.4-14.5)	11.8 (10.2-13.4)
% lifetime abstainers	51.8 (49.3-54.3)	40.4 (36.9-43.8)	62.4 (59.2-65.5)

Challenges: Examples of cost associated with treating cancer

Cancer type	Initial care	Continuing care	End of life care
Breast cancer	\$43,516	\$5,518	\$109,727
Cervical cancer	\$58,716	\$3,956	\$97,026
Colorectal cancer	\$66,523	\$56,246	\$110,144
Leukemia	\$47,264	\$12,701	\$169,588
Lung cancer	\$68,293	\$12,389	\$110,248
Prostate cancer	\$28,109	\$2,603	\$74,227

Challenges

- ❑ Lack of an Act of Parliament on alcohol control
 - ❑ Weak enforcement of the existing regulations
 - ❑ Varying interests; trade, revenue, health, social function and leisure.
 - ❑ Emerging evidence on high level of carcinogenic contaminants in alcoholic beverages in Uganda.
 - ❑ Limited number of higher-level evidence studies in Uganda, esp. risk assessment, due to lack of or limited local research funding opportunities (Jatho et al. 2021).
-

Recommendations

- ❑ Enact a law (Act of Parliament) on alcohol control in Uganda with provisions on regulation of production, packaging, distribution, marketing, sale and consumption of all alcoholic beverage. This will strengthen the legal basis of the Uganda National Alcohol Control Policy (2019).
 - ❑ Set prohibitive fines for the breach of the provisions of the Alcohol Control Act.
 - ❑ Provide for the registration and licensure of all trade in alcohol right from production. Note that this will not reduce the revenue associated with alcohol trade, but instead will increase revenue directly through registration and licensure fees.
-

Recommendations

- Provisions for restricted access to retailed alcohol, limitation of alcohol advertising, regulated licensing and taxes on alcohol are recommended. This will provide for more working time for the economically productive age groups and restricting alcohol access in and in proximity of critical institutions such as schools, health facilities, among others
 - Provide for a strong enforcement measure including enforcement institution capability in this Act.
-

Recommendations

- ❑ Multi-sectoral consideration and a healthy balance of interest especially among; trade, revenue, health, alcohol use for social function and leisure should be evaluated and taken care of in the provisions.
- ❑ Provide for packaging of all alcoholic beverages including locally brewed products such as Kwete, Mulamba, Lacoyi / Maluwa intended for public sale. This will promote value addition and health /safety. This will also tract the provisions on registration and licensure of trade in alcoholic beverages.
- ❑ Provide for quality assurance and monitoring the content of alcoholic beverages in Uganda, relative to the permissible level (upper limit) to ensure public health and safety.
- ❑ Provide for alcoholic beverage content substitution with healthier ingredient

References

- Grewal P, Viswanathan VA. Liver cancer and alcohol. *Clinics in liver disease*. 2012 Nov 1;16(4):839-50.
- Petrick JL, Campbell PT, Koshiol J, Thistle JE, Andreotti G, Beane-Freeman LE, Buring JE, Chan AT, Chong DQ, Doody MM, Gapstur SM. Tobacco, alcohol use and risk of hepatocellular carcinoma and intrahepatic cholangiocarcinoma: The Liver Cancer Pooling Project. *British journal of cancer*. 2018 Apr 3;118(7):1005-12.
- Fedirko V, Tramacere I, Bagnardi V, Rota M, Scotti L, Islami F, Negri E, Straif K, Romieu I, La Vecchia C, Boffetta P. Alcohol drinking and colorectal cancer risk: an overall and dose–response meta-analysis of published studies. *Annals of oncology*. 2011 Sep 1;22(9):1958-72.
- Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, Scotti L, Jenab M, Turati F, Pasquali E, Pelucchi C. Light alcohol drinking and cancer: a meta-analysis. *Annals of oncology*. 2013 Feb 1;24(2):301-8.
- Uganda Ministry of Health. WHO Stepwise Approach to Surveillance (STEPS): Uganda STEPS Survey of Non-communicable Disease (NCD) Risk Factors-2014.
- Boffetta P, Hashibe M, La Vecchia C, Zatonski W, Rehm J. The burden of cancer attributable to alcohol drinking. *international Journal of Cancer*. 2006 Aug 15;119(4):884-7.
- Okello S, Churchill C, Owori R, Nasasira B, Tumuhimbise C, Abonga CL, Mutibwa D, Christiani DC, Corey KE. Population attributable fraction of Esophageal squamous cell carcinoma due to smoking and alcohol in Uganda. *BMC cancer*. 2016 Dec;16:1-6.
- Kim EJ, Hladik W, Barker J, Lubwama G, Sendagala S, Ssenkusu JM, Opio A, Serwadda D. Sexually transmitted infections associated with alcohol use and HIV infection among men who have sex with men in Kampala, Uganda. *Sexually Transmitted Infections*. 2016 May 1;92(3):240-5.
- Zablotska IB, Gray RH, Serwadda D, Nalugoda F, Kigozi G, Sewankambo N, Lutalo T, Mangen FW, Wawer M. Alcohol use before sex and HIV acquisition: a longitudinal study in Rakai, Uganda. *Aids*. 2006

References

- ❑ Okello S, Churchill C, Owor R, Nasasira B, Tumuhimbise C, Abonga CL, Mutiibwa D, Corey KE. Risk Factors of Esophageal Squamous Cell Cancer in Southwestern Uganda: A Case-Control Study.
- ❑ Okello S, Byaruhanga E, Akello SJ, Dwomoh E, Opio CK, Corey KE, Ocama P, Jingshu GU, Muyindike WR, Turesky RJ, Christiani DC. Dietary heterocyclic amine intake and risk of esophageal squamous cell carcinoma in rural Uganda. *International journal of cancer and clinical research*. 2021;8(3).
- ❑ Qian F, Ogundiran T, Hou N, Ndom P, Gakwaya A, Jombwe J, Morhason-Bello I, Adebamowo C, Ademola A, Ojengbede O, Olopade OI. Alcohol consumption and breast cancer risk among women in three sub-Saharan African countries. *PloS one*. 2014 Sep 8;9(9):e106908.
- ❑ Rukundo G, Galukande M, Ongom P, Fualal JO. Red blood cell folate as a risk factor for breast cancer among patients at a tertiary hospital in Uganda: a case control study. *World Journal of Surgical Oncology*. 2014 Dec;12:1-8.
- ❑ Wekha G, Ssewante N, Iradukunda A, Jurua M, Nalwoga S, Lanyero S, Olum R, Bongomin F. Colorectal cancer in Uganda: A 10-year, facility-based, retrospective study. *Cancer Management and Research*. 2021 Oct 7:7697-707.
- ❑ Omoleye OJ, Freeman JQ, Oluwasanu M, Adeniji-Sofoluwe A, Woodard AE, Aribisala BS, Adejumo PO, Ntekim A, Makumbi T, Ndom P, Ajayi IO. Benign breast disease and breast cancer risk in African women: A case-control study. 2023.
- ❑ Rehm J, Patra J, Popova S. Alcohol drinking cessation and its effect on esophageal and head and neck cancers: a pooled analysis. *International Journal of Cancer*. 2007 Sep 1;121(5):1132-7.
- ❑ Ahmad Kiadaliri A, Jarl J, Gavriilidis G, Gerdtham UG. Alcohol drinking cessation and the risk of laryngeal and pharyngeal cancers: a systematic review and meta-analysis. *PLoS One*. 2013 Mar 1;8(3):e58158.
- ❑ Baacker A, Liu Y, La Vecchia C, Zhang ZF. Worldwide incident hepatocellular carcinoma cases

References

- ❑ Islami F, Goding Sauer A, Miller KD, Siegel RL, Fedewa SA, Jacobs EJ, McCullough ML, Patel AV, Ma J, Soerjomataram I, Flanders WD. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. *CA: a cancer journal for clinicians*. 2018 Jan;68(1):31-54.
- ❑ Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, Scotti L, Jenab M, Turati F, Pasquali E, Pelucchi C. Alcohol consumption and site-specific cancer risk: a comprehensive dose–response meta-analysis. *British journal of cancer*. 2015 Feb;112(3):580-93.
- ❑ Cao Y, Willett WC, Rimm EB, Stampfer MJ, Giovannucci EL. Light to moderate intake of alcohol, drinking patterns, and risk of cancer: results from two prospective US cohort studies. *Bmj*. 2015 Aug 18;351.
- ❑ LoConte NK, Brewster AM, Kaur JS, Merrill JK, Alberg AJ. Alcohol and cancer: a statement of the American Society of Clinical Oncology. *Journal of Clinical Oncology*. 2018 Jan 1;36(1):83-93.
- ❑ Hashibe M, Brennan P, Chuang SC, Boccia S, Castellsague X, Chen C, Curado MP, Dal Maso L, Daudt AW, Fabianova E, Fernandez L. Interaction between tobacco and alcohol use and the risk of head and neck cancer: pooled analysis in the International Head and Neck Cancer Epidemiology Consortium. *Cancer Epidemiology Biomarkers & Prevention*. 2009 Feb 1;18(2):541-50.
- ❑ Wu C, Wang Z, Song X, Feng XS, Abnet CC, He J, Hu N, Zuo XB, Tan W, Zhan Q, Hu Z. Joint analysis of three genome-wide association studies of esophageal squamous cell carcinoma in Chinese populations. *Nature genetics*. 2014 Sep;46(9):1001-6.
- ❑ Jatho A, Tran BT, Cambia JM, Nanyingi M, Mugisha NM. Cancer risk studies and priority areas for cancer risk appraisal in Uganda. *Annals of Global Health*. 2020;86(1).

Thank you

