Introduction
Epidemiologic studies for many decades have consistently shown that, when compared with non-drinkers, light-to-moderate consumers of alcoholic beverages have a lower risk of cardiovascular disease (CVD), and also show a reduced risk of total mortality. In most studies that contain an adequate number of heavy drinkers, such subjects show a greater risk than moderate drinkers as well as non-drinkers; this phenomenon results in what is known as a “J-shaped curve.”

While many of the early studies included ex-drinkers in the non-drinking referent group (that may have increased the risk of disease for “current abstainers”), a similar J-shaped curve has almost always been seen in more recent studies when only lifetime abstainers make up the non-drinking category. Numerous improvements in epidemiologic & statistical techniques, as well as better definition of potential confounders, have provided even clearer results from observational epidemiologic studies (Ronksley et al, 2011; Midlov et al, 2016). Randomized control trials in humans (Brien et al, 2011) and essentially all animal experiments have shown a similar pattern: beneficial effects on risk factors and disease with light-to-moderate alcohol exposure, adverse effects with large amounts; even when repeated estimates of alcohol intake are used to construct trajectories of consumption, Passos et al (2017) have recently shown a J-shaped curve between alcohol and CVD; and the opposite is seen when studying the quality of life: higher scores for subjects reporting moderate drinking and lower scores among both abstainers and those with heavy drinking (Schrieks et al, 2016).

Differences between a linear and a J-shaped curve
Wikipedia defines a J-shaped curve as “A variety of J-shaped diagrams where a curve initially falls, then steeply rises above the starting point.” For the consumption of wine and other alcoholic beverages, this means a decline in risk (of heart disease, dementia, total mortality, etc.) for intake up to a certain level of drinking, a return to the same risk as non-drinkers with a little more alcohol, and then an increase in risk for heavy drinking. For most middle-aged or older adults (unless there are contraindications to any alcohol from previous abuse, severe liver or certain other diseases, etc.) current scientific data indicate that the message in terms of health is “a little alcohol is good for you, a lot of alcohol is bad for you.”

Focus on the data, not extrapolation of effect into levels with little or no data
The first important element when looking at J shaped curves, is that the overwhelming percentage of participants in studies drink one or two drinks a day, 87% consume < 12 g/day; almost none above 30 grams/day, which means the upper end of the curves reflect a extrapolation of effect into levels with little or no data.
Separate curves by type of beverage

Does the type of beverage matter? While most epidemiologic studies indicate that moderate drinking of any type of alcoholic beverage is associated with a lower risk of CVD, an increasing number of both animal experiments and human trials are demonstrating that the polyphenols and other non-alcoholic substances in wine and in some beers provide additional protection against disease. Such effects are especially important for wine when it is consumed with food, as has been recently summarised by Boban et al, 2016. It is anticipated that when more accurate assessments of actual alcohol consumption and drinking patterns become available, even greater protection against disease from moderate drinking will be shown, from beverages high in polyphenols drunk in moderation, ideally at mealtimes.

1,500 women followed for 34 years by Mehlig et al (2008), large differences in risk of dementia were present according to the predominant beverage consumed. For subjects consuming some wine, the risk (versus non-drinkers) was 0.6 (95% CI 0.4, 0.8) while among those reporting that the only alcoholic beverage they consumed was wine, it was 0.3 (95% CI 0.1, 0.8), a 70% lower risk. It should be noted however, subjects whose predominant beverage was spirits showed a 50% greater risk of dementia (HR=1.5, CI 1.0, 2.2).

Similarly, Wu et al (Eur J Epidemiol 2017) found dementia risk was reduced for light-moderate consumers of wine (by 42%), but not significantly related to dementia risk for light-to-moderate consumers of either beer or spirits.

Base curves on studies with repeated assessments of alcohol intake so that “changes” can be evaluated

A report by King et al, 2008, from the ARIC study used repetitive assessments of alcohol consumption to judge the effects of changes in alcohol intake. In comparison with non-drinkers who continued to not consume alcohol, those subjects who subsequently began to drink moderately had a HR of 0.62 for incident CVD, a 38% reduction in their risk. Similarly, in their study of changes over time in alcohol intake, Powers et al (2008) found the moderate drinkers who continued to drink had the highest rating of overall health.
Make curves more age-specific (separate young people from middle-aged and older adults)
When a physician is giving advice regarding alcohol consumption to an individual patient, he uses data appropriate to the age of the subject. For example, when discussing the alcohol with a 50-year-old patient, at an age when cardiovascular disease begins to appear, he/she will focus on the potential risk/benefits that a 50-year-old can expect with alcohol consumption. He/she will not focus on the effects among young people; given that the “diseases of ageing” are of little regard for a 25-year-old, advice regarding alcohol intake would be quite different as the dangers of excessive drinking more important. Thus, data should be age-specific when being used to advise individual patients.

In an early report from Rehm et al (2007), deaths attributable to what the authors considered “moderate” consumption (an average of < 40 g/day for men, < 20 g/day for women, and including binge drinkers as well as regular drinkers), they showed increased risk among the young.

While showing increases in deaths among the young, the inclusion of binge drinkers within the “moderate” group was worrying. When he excluded the binge drinkers from the “moderate” group, most of the increases in the young disappeared.

These findings between young and older adults only emphasize the importance of tailoring advice according to age: the beneficial health effects are predominantly among older subjects. These striking changes also emphasize the next suggestion for refining the J-shaped curve: focusing on the “pattern of drinking,” regular and moderate, with no beneficial effect for those who binge drink, quite the opposite in fact.

Separate curves by patterns of drinking (binge vs. regular moderate, with or without food)
Increasing data show that “how” you drink may be more important (up to a certain level) than the “how often” you drink. Seeking a better measure of the “exposure” to alcohol; the importance of the pattern of drinking.

It is unfortunate that most epidemiologic studies have been forced to use only the average amount of alcohol consumed (over a week or month) as the measure of exposure. Most have been unable to adequately control for the pattern of drinking, even though it is clear that regular moderate consumers of alcohol have considerable health advantages over binge drinkers of the same average amount. Mukamal et al (2005) found that binge drinking (versus no binge drinking) eliminated the protective effects of alcohol on mortality among subjects who had suffered a myocardial infarction.

Piano et al (2017) recently reported that binge drinking was associated with many adverse cardiovascular effects; specifically binge drinking in middle-aged and older adults was associated with a higher risk of hypertension, myocardial infarction, and stroke. Further, these authors found that binge drinking in the young (18-30 years) had adverse effects on blood pressure, endothelial function, and cardiac arrhythmias. Many animal experiments show the same pattern; for example, Liu et al (2011) found completely different effects on coronary atherosclerosis induced among mice when the same amount of alcohol was administered on a daily basis (a decrease in atherosclerosis) versus only on two days of the week (an increase in atherosclerosis).

For Example, Bagnardi et al. (2008) showed very different associations with the risk of coronary heart disease according to whether the consumer was a “regular drinker” or an “irregular drinker,” with the latter being subjects who consumed alcohol only on the week-end.
Further, one key aspect of the pattern of drinking is whether or not the consumption of alcohol is with food or not. It has been repeatedly shown that the peak blood alcohol concentration following a given amount of alcohol consumed in conjunction with food intake is about 50% lower than when the same amount of alcohol is consumed during a meal. "Never drink without eating," is good advice; also, as the rate of consumption of alcohol relates to blood alcohol increase, the advice of Serge Renaud that “You drink water, but you sip wine” is also important.

Evaluating effects of “under-reporting” of alcohol intake by subjects in epidemiologic studies

Another important aspect of the pattern of drinking relates to the problem of “under-reporting” of alcohol intake by subjects in epidemiologic studies. In epidemiologic studies, adding self-reported information on the frequency of binge drinking to analyses has only partly corrected the problem of mixing regular moderate drinkers and binge drinkers in the same category. Klatsky and Udaltsove (2007) have found from their very large Kaiser-Permanente cohort that a more accurate identification of subjects who are “under reporters” of their alcohol intake improves the precision of estimates of effect. For mortality, these authors report: “The analysis reconfirms that the relation of alcohol drinking to total mortality is J-shaped, with reduced risk (mainly because of less cardiovascular disease) for lighter drinkers and increased risk for persons reporting more than 3 drinks per day. Infrequent (occasional) drinkers have risk similar to that of lifelong abstainers, while former drinkers are at increased risk, especially for non-cardiac death. The general shape of the relation of alcohol to mortality is similar for men and women. Age differences are substantial, with the apparent benefit from light-moderate drinking not seen before middle life. Our data indicate further that the apparent magnitude of benefit of lighter drinking is probably reduced by systematic underreporting.” Their subsequent analyses have strengthened this premise, indicating that underreporting of alcohol intake affects the apparent risk for cancer as well; they found that when recognised under reporters are removed from the analysis, the risk of cancer from moderate drinking is essentially nil (Klatsky et al, 2014).

Make alcohol exposure (X-axis) a sliding scale

We know that people differ markedly in their response to varying levels of alcohol intake. Regular moderate drinkers may show few effects of a given amount of alcohol that would result in marked effects suggesting drunkenness in other people, especially older or frail people not accustomed to drinking. For example, for an elderly frail man who never drinks but wants to have a “sip of sherry” in the evening, the physician would not use a curve suggesting that up to two drinks/day may be recommended; the point of “safe” intake could be much lower. Thus, when showing a J-shaped curve to an individual patient, the point where adverse effects exceed beneficial effects can vary, depending on the age, drinking habits, and health conditions.

Switch to survival curves

Finally, I have found it easier to discuss potential adverse or beneficial effects of alcohol with individuals by forgetting the J-shaped curve, and focusing on survival curves of subjects at any given age according to whether or not they consume wine or other alcohol-containing beverage. As an example, consider the survival curve for a 50 year old subject shown by Streppel et al (2009) according to whether a subject consumes no alcohol, beer or spirits, or wine.
In these data from men in the Zutphen with an assessment of long-term alcohol intake, those who consumed an alcoholic beverage, especially those consuming wine, had lower risk of death over time (although, as we should not forget, everyone eventually dies). The latter brings up the typical findings that the self-reported quality of life is greater for moderate drinkers than for abstainers: you may live longer and enjoy it more.

**Focusing on a “Healthy Lifestyle”**

When using any type of chart or figure to illustrate the effects of moderate drinking, it is key that alcohol consumption should be considered only one component of lifestyle behaviours related to health. Our colleagues in the large, long-term epidemiologic studies at Harvard (including the Nurses’ Health Study and the Health Professionals’ Follow-up study) have defined a “healthy lifestyle as having five components:

- Don’t smoke
- Stay lean (avoid becoming obese)
- Exercise regularly
- Eat a healthy diet (e.g., a Mediterranean-type diet with lots of fruits, vegetables, whole grains, etc.)
- Unless contraindicated, consume a small amount of an alcoholic beverage with food regularly.

These investigators have found that subjects who meet all 5 criteria for lifestyle have dramatically lower risk of CVD, diabetes, and total mortality (usually greater than 90% reduction) when compared with subjects meeting none of these criteria. And each of the five components gives a significant addition to the protection against morbidity and mortality. So make the focus of advice to patients on the complete package, including the alcohol component unless it may be contraindicated by past alcohol misuse, liver disease, other health conditions, religious restrictions, or desires of the patient.

**Public health implications of a J-shaped curve**

As of 2019, essentially all epidemiologic studies continue to show a J-shaped curve, especially for CVD and mortality. The BMJ meta-analysis published in late 2011 represents the most complete meta-analysis to date. It found no differences in the extent of relative risk reduction in cardiovascular disease mortality when classification adjustments were made to address the sick quitter misclassification hypothesis. Of the 4235 studies considered and 84 studies involving over one million people included in the final analysis, the pooled estimates showed a lower risk of all-cause mortality for drinkers compared with non-drinkers (relative risk, 0.87; 95% CI, 0.83–0.92). mja.com.au/journal/2013/198/8/j-curve-revisited-cardiovascular-benefits-moderate-alcohol-use-cannot-be#0_CBBDHHCH

Some health officials suggest that the public should be advised to focus on the nadir of the J-shaped curve for making decisions about drinking. Instead, many moderate drinkers are inclined to view the point on the curve where the risk of adverse health outcomes exceeds that of abstainers, a point that indicates when the level of drinking may begin to be less healthy than the risk associated with abstinence. Chokshi (2016) has pointed out that the marked differences between a linear curve and a J-shaped curve cause problems for public health messages. “Traditional messages such as restrict, ban, etc. work for linear relations between exposures and health (e.g., for cigarettes, illegal drugs) – ‘Just say no!’ However, they work less well for an exposure with a ‘J-shaped’ relation with health, such as wine.” In can be argued that, on the other hand, most people can appreciate that taking a little of something (e.g., a glass of wine) is different from taking a lot of it (e.g., a bottle or two of wine). The J-shaped curve provides an accurate portrayal of the scientific data relating alcohol to disease outcomes.

**References**


Connor J. The life and times of the J-shaped curve. Alcohol Alcohol 2006; 41: 583–584


