

## **Standard Drink in the Dietary Guidelines for Americans (DGA)**

### **Introduction**

This study, provided by the Center of Alcohol Studies (CAS) at Rutgers, the State University of New Jersey, suggests the need for a more accurate representation of potential risks of alcohol consumption in the DGA in terms of both short-and long-term health consequences related to level of consumption. The current DGA lacks sufficient reference to, and guidance about, the complexity of pharmacokinetic variables and their pharmacodynamic implications to provide adequate instruction for those who choose to consume alcohol in any of its commercially available forms (e.g., beer, wine and distilled spirits). As such, the DGA fails to provide the American public with a basis for accurately correlating the “Standard Drink” (as defined in the current DGA) to blood alcohol concentration (BAC), the ultimate marker of alcohol exposure used in legal, scientific, and public realms. This problem makes it difficult, at best, for the American public to gauge the level of short and long-term exposure to beverage alcohol, hence to make rational scientifically-based decisions about drinking practices. In addition, adoption of the current definition of a Standard Drink for the next iteration of the DGA possesses a series of practical and scientific problems for scientists and policy makers studying American drinking practices and outcomes.

CAS has been a worldwide leader in multidisciplinary alcohol research, prevention, and education and training, as well as publication and dissemination of alcohol information dating back to the early 1940s. This report is the executive summary of an independent scientific investigation on the origin and concept of the “Standard Drink” and the reference amount of ethanol from multiple historical, biomedical, and scientific perspectives. Research methodology utilized in this study includes searching scholarly databases provided by Rutgers University Libraries for relevant articles and reviewing, selecting, and organizing resources, resulting in a review of the scholarly literature, the current executive summary, a list of the occurrences of alcohol and “Standard Drink” in the Dietary Guidelines for Americans (Appendix 1), and an annotated bibliography of selected seminal scholarly articles (Appendix 2).

It should be noted that the influence of the “Standard Drink”, as it is currently defined, is not limited simply to its inclusion in the Dietary Guidelines for Americans discussed here, but guidelines and instructions provided by other organizations such as the National Highway Traffic Safety Administration (NHTSA), Center for Disease Control Prevention (CDC), and Federal Aviation Administration (FAA), a review of which is outside the scope of this study. The accuracy of definitions of a “Standard Drink” also extends to calculating Standard Drink units for research purposes (e.g., Brick, 2006; Cooper, 1999; Flegal, 1991; Logan & DiStefano, 1999; Martin & Nirenberg, 1991; Miller, Heather, & Hall, 1991; William, 2005). It also affects drinking practices, including self-report, choice of beverage, and the phenomena related to “over pouring” (e.g., Boniface, Kneale, & Shelton, 2013; Brick, 2006; Cahalan & Cisin, 1968;

Carruthers & Binns, 1992; Devos-Comby & Lange, 2008; Geller, Russ, & Altomari, 1986; Kerr et al., 2008; Kerr & Stockwell, 2012; Kerr et al., 2013; Lemmens, 1994; Smart, 1996; Stockwell et al., 2004; White, 2005). Understanding the concept of standardized measures of alcohol consumption is also intertwined with the economics of alcohol pricing and taxation (e.g., Elder et al., 2010; Cook & Moore, 1993; LaBianca, 1992); however, discussions of these issues are deemed outside the scope of the current study.

### **Background: The Dietary Guidelines for Americans**

The first edition of the Dietary Guidelines for Americans (DGA) was released in 1980 without mentioning the concept of a “Standard Drink” for alcohol consumption, but recommending drinking alcohol in moderation (DGA, 1980, p.19). The “standard-size drink” was first defined in the 1985 edition, stating that “twelve ounces of regular beer, 5 ounces of wine, and 1 ½ ounces of distilled spirits contain about equal alcohol” (DGA, 1985, p.23) and a DO NOT DRIVE warning was added to the phrase about moderate drinking. The 1990 edition features an even more explicit and gender-specific definition about moderate drinking, including a specified 80 proof strength for distilled spirits (DGA, 1990, p.26). The subsequent edition introduced the calorie counts for standard drinks (150 calories for beer, 100 for wine, and 100 for distilled spirits). Notable is the missing warning regarding drinking and driving (DGA, 1995, Box 16). Year 2000 defines “drinking in moderation”, still very prominently in a separate box, with even more focus on calories, claiming that “even moderate drinking provides extra calories” (DGA, 2000, Box 26). Standard drinks no longer stand out in the 2005 edition. Instead of a box and highlights, the definition is only a single paragraph of the Discussion section (DGA, 2005, p.44) with the calorie count information deleted. The alcohol content of a standard portion is first inserted in the 2010 edition in a highlighted box containing the statement “one drink is defined as 12 fluid ounces of regular beer (5%), 5 fluid ounces of wine (12% of alcohol), or 1.5 fluid ounces of 80 proof (40% alcohol) distilled spirit. One drink contains 0.6 fluid ounces of alcohol” (DGA, 2010, p.21. For more details, please see Appendix 1).

The main stated purpose of the DGA is to lay the foundations of health policy and to reduce the prevalence of alcohol misuse by promoting drinking in moderation while raising awareness about quantities consumed. Worldwide recommendations do not adequately accommodate science (Harding & Stockley, 2007). The notion of Standard Drink varies internationally and survey results show an underestimation of alcohol consumption (e.g., Devos-Comby & Lange, 2008; Brick, 2006; Kerr et al., 2013). A gray area of consumption level between moderate and “risky” drinking was identified and found to be associated with the risk of harms, a notable concept due to the large proportion of drinkers in this category; that is, 29.1% (Dawson & Grant, 2011). The recent DGAs shift the emphasis to the value of caloric balance and nutrition (Marshall, 2011).

DGA roots can be traced back as early as Benjamin Rush (1790). Post-Prohibition research and policymaking include Henderson’s *A new deal in liquor* (1934). In Europe in the 1930’s, E.M.P.

Widmark began his pioneering research on calculating blood alcohol concentrations in humans, which included reliance upon understanding alcohol content in various beverages as well as alcohol content in “drinks”. Hence, in the post-prohibition environment, conceptualizing alcohol within the context of toxicology meant that drinking was not regarded as only a social or individual problem, but also became the subject of serious scientific investigations. Likewise, information dissemination was considered a necessary adjunct to scientific research (Pauly, 1994). The review of alcohol literature by Norman Jolliffe and E.M. Jellinek sponsored by the Carnegie Corporation led to the establishment of educational, treatment, research, and information dissemination initiatives at Yale that culminated in the creation of the Yale Center of Alcohol Studies (the predecessor of the current Rutgers Center of Alcohol Studies). Yale CAS became and remained the ultimate research center on alcohol, involved in every related field (Jellinek, 1947; Jellinek, 1952; Bacon, 1962; Candon, Ward, & Pandina, 2014). The work of CAS arguably has stimulated the expansive growth of research that now counts dozens of centers worldwide devoted to the study of alcohol consumption.

In the 1970s, as part of its founding and fundamental mission, the National Institute on Alcohol Abuse and Alcoholism (NIAAA) was charged with the duty of systematically documenting acute and chronic health consequences of alcohol use and defined “the typical drink” as three-fourths ounce of alcohol provided by a “shot” of spirits (1.5 oz, 40 to 50 percent alcohol), a glass of wine (5 oz, 12 percent alcohol), or a pint of beer (16 oz, 5 percent alcohol) (NIAAA First Special Report, 1971, p.37). Note that this purported set of “equivalencies” is itself inaccurate. Presumably, the NIAAA effort built upon the early survey research methodology of early alcohol research pioneers including Straus & Bacon (1953), Mulford & Miller (1959), and Cahalan & Cisin (1968), as well as other early chroniclers of American drinking practices.

The Dietary Guidelines for Americans (DGA) currently include alcohol as little more than a footnote, mostly focusing on caloric data, the equivalencies of the different alcoholic beverage types, and a blanket statement on moderation. If alcohol is to be included in the DGA, there needs to be a more nuanced focus on alcohol burden on the individual. We have reviewed the history of alcohol in the DGA dating back to 1980 and compared their output with the scholarly literature available on the subject, and we find the DGA inclusion lacking.

The 2010 DGA (the most recent) define moderate alcohol consumption as “one drink per day for women and up to two drinks per day for men.” Sanchez-Craig (1995) defines moderate drinking as “levels that do not interfere with or threaten one’s health, social relationships, daily obligations, or safety and the safety of others.” This somewhat abstract definition combined with previous research leads to a more concrete definition of moderate drinking for so-called “problem-drinkers”: no more than four standard drinks in any day on no more than three days a week for men, and no more than three drinks a day on no more than three days a week for women. Broken down further, they advise not drinking more than one drink in a given hour and not drinking at all if planning on driving or performing other potentially hazardous activities, if pregnant or breastfeeding, if at work, or if on any medication. Further, the study recommends an

upper limit of 16 weekly drinks for men and 12 for women, and not to drink as a means of coping with problems. Although the guidelines do not specifically reference the concept, there appears to be an inference to the notion of total alcohol burden (TAB) or total alcohol exposure (TAE) acutely and/or chronically as these relate to health risks and consequences. In any event, such concepts are not explicitly defined quantitatively in terms of alcohol exposure.

Putting aside the different quantitative results, comparing these two definitions highlights the deficit in terms of variability and customizability in the DGA. As the NIAAA points out in its *State of the Science Report on the Effects of Moderate Drinking*:

The difficulty in defining moderate drinking is to some extent a result of individual differences. The amount a person can drink without intoxication may vary according to drinking experience and tolerance. Individual metabolic differences can lead to a wide range of BAC levels for the same consumption. Also important is the time over which the alcohol is consumed. Thus, definitions solely based on the number of drinks are not the best approach. (<http://pubs.niaaa.nih.gov/publications/ModerateDrinking-03.htm>)

This report was composed in support of the 2005 DGA, to provide a review of the best evidence on the health risks and potential benefits of alcohol consumption. An extensive bibliography is offered in support of the 11,000-word document, which details the following topics: the pharmacokinetics and pharmacodynamics of alcohol, demographics of consumers, the definition of "moderate", drinking patterns, and drink sizes. With such a significant amount of research invested in the cause, it is surprising that the final output represented in the NIAAA document as it appears was so general and limited. In 2010, the DGA did not add much more, essentially giving the same equivalencies but with the addition of providing alcohol content measures.

### **The "Standard Drink" in practice**

A Standard Drink is straightforward to define in theory (e.g., the DGA defines it as 0.6 fluid ounces of pure ethanol, DGA, 2010), but much harder to discern in practice. William's (2005) study concluded that there was a slight increase in the amount of alcohol in one "drink" when drinkers chose wine (0.67 oz) and a significantly large increase when drinkers chose spirits (0.89 oz), as opposed to the lower than average alcohol content when choosing beer (0.56 oz). Gill & Donaghy (2004) add support to this study, finding that surveys based on the assumption that consumers know how much goes into a standard drink must be called into question. White et al. (2003) notes that college students overpoured shots by 26%, mixed drinks by 80%, and beer by 25%. White et al. (2005) also note underreporting in self-reports of drinking among college students, finding that they tend to pour single servings of beer and liquor that are larger than the strictly defined standard drink. Carruthers & Binns (1992) found that knowledge of the alcohol content of beverages and what the term "Standard Drink" represents was very poor. Stockwell et al. (2004) discuss several reasons for under-reporting in self-surveys, including under-sampling of high-intake drinkers, poor recall of past alcohol consumption, inability to make accurate

estimates, and the inaccuracy of assumed standard drink sizes. A study by Lemmens (1994) points out that the average self-reported drinks taken at home contained more than the presumed standard, with a highest deviation for distilled spirits (+26%). DeVisser & Birch (2012) had results along similar lines, finding that the drinks made in their experiment of students ranging from age 16-25 tended to be substantially larger than a single standard drink. In a study to estimate the actual alcohol content of drinks served in bars and restaurants, the average wine drink was found to contain 43% more alcohol than a standard drink, with no difference between red and white wine. The average draught beer was 22% greater than the standard. Spirit drinks differed by type with the average shot being equal to one standard drink, while mixed drinks were 42% greater (Kerr, Patterson, Koenen, & Greenfield, 2008).

### **Standard Drink viewed internationally**

When viewed from a global perspective, the definition of a Standard Drink becomes even more nebulous. Turner (1990) shows a wildly divergent definition of “Standard Drink” along international lines, ranging anywhere from 8 grams of ethanol in the U.S. to 28 grams in Japan. Cooper (1999) agrees, suggesting that “the usefulness of the ‘Standard Drink’ hinges upon international consensus on the way in which it is defined.” Miller et al. (1991) plead for a common method of reporting alcohol consumption among the U.S., Canada, the UK, and Australia, suggesting metric fluid volume. Gual et al. (1999) find that the average alcohol content of a drink in a viticultural society such as Spain is very similar for wine and beer, but is almost double in the case of spirits. Kerr & Stockwell (2012) agree that the definition of a Standard Drink not only varies across countries, but typically contains less alcohol than actual drinks. They advocate Standard Drink labeling as a way to help track alcohol intake, in concert with other suggestions of more visible Standard Drink labeling (Jones & Gregory, 2009). Stockwell, Blaze-Temple, and Walker (1991) add support to this initiative, showing that a majority of drinkers prefer a “Standard Drink” label as opposed to alternative types. The same general conclusions are reached by other investigators (e.g., Brick, 2006).

In light of this extensive research, it begins to become clear that the Standard Drink measure, as published in the DGA, is not very useful in a practical sense, particularly in that it does not take into account the wide and disparate alcohol content in various beverages, nor does it take into account the well-documented drinking practices of the public as a whole, both domestic and along international lines. There are numerous important variables that must be taken into account if the DGA’s section on alcohol is to be useful in the future in informing the American public regarding the potential health risks and consequences of alcohol exposure. These include, but are not limited to: gender, time frame of a drinking episode, alcohol tolerance, body weight, achieved blood alcohol content, TAB and TAE, developmental stage of the drinker, and the health status of the drinker, to mention a few.

### **Pharmacokinetic considerations and pharmacodynamic implications**

It should be noted that, in a historical context, alcohol consumption was viewed from a toxicology perspective first, and beer was not considered intoxicating. Henderson (1934), a toxicologist, argued that alcohol is a poison and problematic only above a certain threshold. His new scientific concept had a significant impact on the politics of repeal and the legitimization of alcohol consumption (Pauly, 1994).

Research in pharmacokinetics evolved parallel with toxicological concerns. Quantitative methods for the determination of alcohol in blood, breath, and urine appeared early in the twentieth century in several European countries (Jones, 2000). The seminal work of the Swedish scientist E.M.P. Widmark was published in 1932 in German, opening a new chapter from the forensic aspect. His formula has been used to determine the elimination rate of alcohol from blood ever since (English translation: Widmark, 1981). Blood alcohol concentration (BAC) research became the focus of clinical pharmacokinetics and forensic toxicology (e.g., Wilkinson, 1980; Jones, 1991; Holford, 1987; Jones, 1993), taking into consideration potential variables such as age, gender, nutrition, body weight, health status, type of beverage, period of drinking and individual differences (e.g., Jones, 1993; Jones & Andersson, 1996; Jones & Jonsson, 1994; Stowell & Stowell, 1998; Jones, 2008; Jones, Jorfeldt, Hjertberg, & Jonsson, 1990; Jones, Wigmore, & House, 2006; Norberg, Jones, Hahn, & Gabrielsson, 2003). A simple device to estimate blood alcohol levels is the ALCO-CALCULATOR with equivalencies and more variables (Lester & Pandina, 1983). Instructions guide users to parse out all equivalencies and variables based on scientific principles (Lester & Pandina, 1983). Other such devices are commercially available as are computer assisted programs. With about 20 mathematical formulas and methods to estimate alcohol consumption, and considering circumstantial variables, the standardization of alcohol calculations in research is strongly suggested (Brick, 2006).

Even from the pharmacokinetic perspective, the definition of the Standard Drink is not straightforward due to the variability of alcohol content within the beverage types and the kinetic and dynamic variables of the individual. The utility of the equivalencies is mitigated by the fact that beverages within each category can vary in alcohol content substantially, leading to misleading notions of equivalencies. For example, beer ranges from some light beers with an alcohol by volume (ABV) of 3.5% up to craft beers with an ABV of over 12%. Even if one can specify the alcohol equivalencies when projecting a Standard Drink as portion size, these often have little or no relevance as to how actual drinks are poured or served, whether in a bar environment or at home (Kerr et al., 2008; Kerr & Stockwell, 2012; Boniface et al., 2013; Devos-Comby & Lange, 2008; White et al., 2005). Other dynamic factors may influence acute alcohol exposure and total alcohol burden, such as the rate of ethanol elimination from blood, the amount of ethanol ingested per unit of time, the drinking habits of the subjects, and the effect of food taken together with, or before, drinking. As an example of the variability between individuals, Jones (1993) and Jones & Jonsson (1994) observed the fastest rate of ethanol

disappearance in a male chronic alcoholic during detoxification and the slowest in a healthy male subject. Other such examples dot the scientific literature.

Hence, the kinetic and dynamic variability of individuals and drinks can have an impact on expected behavioral changes when individuals believe they are consuming a Standard Drink as compared to an actual “serving”; that is, a “drink” actually poured during a drinking episode. In as much as impairment in cognitive, affective, and psychomotor performance is a function of BAC, the pharmacodynamics, the impact of alcohol on one’s abilities or behaviors, should be accurately linked to the pharmacokinetics and related variables specified above. This is an important and standard practice employed by scientists studying the impact of alcohol on behavior throughout the history of alcohol studies. The literature in this regard is extensive and a review of the literally thousands of studies is beyond the scope of this executive study. A few examples provide a flavor and range of the literature linking BAC to behavioral outcomes. For example, Smart (1996) reports a difference in the behavioral and social consequences related to the consumption of various beverage types in terms of the speed of increasing BAC, impairment, emotional and aggressive responses, alcohol-related problems, and driving under the influence. Friedman, Robinson, and Yelland (2011) indicate that cognitive function can be impaired at BACs even below the legal limit for driving as shown by the trend of slower response and more error under mild intoxication. Murdoch, Pihl, and Ross (1990) found that alcohol is associated with violent crime at a greater than chance level and at a significantly higher level than it is associated with nonviolent crime. Zhang, Welte, and Wiczorek (2002) call attention to the multi-dimensional nature of the link between alcohol and violence, and also claim that “the link between alcohol and violence is not only a matter of the consequences of drinking, but is also about what individuals believe about the consequences of drinking.”

The significance of employing accurate pharmacokinetic and pharmacodynamic aspects of alcohol consumption extends to practical forensic toxicological analysis in traffic incidences involving intoxicated drivers, as well as other varieties of serious incidents involving intoxicated individuals. Thus, accurately determining the amount of alcohol content in various bodily fluids and tissues has implications in terms of the perceived and actual impairment of an individual under a variety of circumstances. In such cases, psychomotor, affective, and cognitive impairments and behavioral consequences often rely upon the retrograde extrapolation of blood alcohol content by estimating BAC levels and related impairments. In cases where specific BAC determinations (e.g. blood samples) are not available, such extrapolations often rely upon reports of consumption of “Standard Drinks”. Likewise, such forensic determinations often involve estimates of “Standard Drinks” consumed or alternative “drinks served” when BAC levels are determined from bodily fluids and tissues. In some cases, “served drinks” do not necessarily comport with “Standard Drinks”.

Thus, the DGA’s task (and for that matter any such guidelines proposed by an authoritative group or organization advising on the subject of alcohol’s influence on behavior) ought to be to communicate and educate, in a simplified, yet scientifically accurate and appropriate way, the

fact that one's abilities and behaviors are influenced by alcohol consumption related to blood alcohol concentration (acutely and chronically), not simply by an arbitrary number of highly variably defined and potentially misleading notions of "Standard Drinks". Additionally, such guidelines and advisories should refer to health risks for the individual or for the greater society. Guidelines should consider both acute risks such as the impact on driving behavior, operating machinery, flying, or performing intellectual activities and chronic health risks, such as the long-term consequences of one's drinking patterns, whether a single binge drinking episode, or uniting all drinking experiences, including multiple low-level episodes. Risk tables should be designed based on the exposure to alcohol and related alcohol exposure either in a single drinking episode, or over a period of time up to and including one's entire lifespan in order to calculate the total alcohol burden on the individual, an indicator of the long-term health risks of that individual. It is ill-advised to make equivalencies between the Standard Drink and BAC without taking into account all of the pharmacokinetic variables and their pharmacodynamic implications.

### **Conclusion**

A clear and concise understanding of what constitutes a "Standard Drink" as it affects one's blood alcohol concentration is critical for informing the American public about the potential health risks and consequences of drinking practices either in a single drinking episode or over longer periods of exposure, as well as for formulating public policies related to alcohol production, distribution, sale, and consumption. In order to be useful, health related communications about "Standard Drinks" and "standard drinking practices" should be based not only upon theoretical constructs embedded in relatively straightforward pharmacokinetic principles, but also, arguably as important, must consider the myriad of well documented factors regarding the actual drinking practices and outcomes of the American public. Without such considerations, health-oriented communications regarding drinking have little or no value in informing the public and, as such, will have little impact upon American drinking practices. Hence, any guidelines whose goals include influencing important health decisions about alcohol must follow the science of alcohol studies in its totality or remain an ineffective and obscure exercise. The extent to which such guidelines, including the efforts reflected in the *Dietary Guidelines for Americans*, currently under review, fall short of recognizing issues raised here will likely be reflected in the public's lack of confidence in such pronouncements and ultimately in the lack of intended impact.

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## **Appendix**

1. Alcohol in the Dietary Guidelines (DG 1980-2010)
2. References: Standard Drink

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