

## Tea and Cancer

### **Introduction**

Cancer is a major cause of morbidity in the UK with approximately 270,000 newly diagnosed cases, and around 150,000 deaths from cancer each year. It is expected that more than one in three people in England will develop cancer at some stage in their lives.<sup>1</sup> The disease is more likely to develop in later life, with around 75% of deaths from cancer being diagnosed in people over the age of 65<sup>1</sup>. However, although there are fewer deaths from cancer in younger people, cancers cause a greater proportion of deaths: 1 in 3 (37%) deaths in adults aged under 65 years are caused by cancer.<sup>1</sup>

### **What is cancer?**

Cancer is often thought of as a single disease, however in reality it is a term that covers a range of malignant conditions that can affect almost any organ or tissue in the body. Cancer occurs when tissue cells are no longer under the control of normal molecular regulatory processes that usually result in the division, differentiation and ultimately death of these healthy cells. When these control mechanisms become disturbed the cells divide in an uncontrolled and abnormal manner, often failing to differentiate and failing to respond to the usual death signals. In most cancers this uncontrolled growth results in the formation of a tumour.

In many cancers the malignant cells will migrate from their primary tissue of origin to secondary sites creating secondary tumour growths or 'metastases'. The lethal effects of both primary and secondary cancers is due to the compression of healthy cells, often killing them, so preventing the normal functioning of major organs.

### **Causes of cancer**

The vast majority of cancers are caused by a disorder of cellular genetic material. Damage to the DNA within the cells maybe as a result of environmental factors such as radiation, chemical carcinogens and some viruses.

Certain risk factors are associated with different types of cancer, and some of these are modifiable<sup>1</sup>:-

- Smoking is the greatest known risk factor for cancer
- UV (Ultraviolet) Radiation, specifically UVA and UVB, cause skin damage, including sunburn and premature ageing of the skin. This damage can eventually lead to skin cancer
- Experts think that about a quarter of all cancer cases are caused by unhealthy diets and obesity. Diet influences a number of cancers including cancers of the bowel, stomach, mouth, oesphagus and breast

- Excessive alcohol consumption strongly increases an individual's risk of developing oral cancer, laryngeal cancer, liver cancer and oesophageal cancer
- Around four percent of all cancer deaths maybe caused by exposure to certain chemicals

## **Diet and cancer**

More and more research is finding that diet plays a crucial role in the prevention of cancer. A joint WHO/ FAO Expert Consultation report<sup>2</sup> has estimated that dietary factors account for approximately 30% of cancers in industrialised countries. There is *convincing* evidence that being overweight and obese increase the risk of cancer, as well as consuming large amounts of alcohol, aflatoxins, and some forms of salted and fermented fish. Factors which *probably* increase risk include high dietary intake of preserved meats, salt-preserved foods and salt, and very hot (thermally) drinks and food. *Probable* protective factors are consumption of fruits and vegetables. After tobacco, overweight and obesity appear to be the most important known avoidable causes of cancer.

Findings from the world's largest investigation into diet and cancer, EPIC (European Prospective Investigation into Cancer and Nutrition), monitoring approximately 500,000 individuals in 10 European countries, have found that

- High intakes of fibre reduce bowel cancer
- High intakes of red or processed meats increase bowel cancer
- Eating lots of fish may reduce bowel cancer
- Being overweight and obese increase the risk of breast cancer in post-menopausal women
- Overweight and obesity also increases the risk of cancer of the kidney
- High intakes of saturated fat increases the risk of breast cancer
- High levels of fruit and vegetables reduce the risk of dying early from any cause by 20%
- High intakes of milk and cheese, and high levels of calcium in our diet, are linked to a reduced risk of bowel cancer.

## **Dietary Recommendations**

The World Cancer Research Fund<sup>3</sup> has made the following dietary recommendations:-

- Increase fruit and vegetable intake - at least 5 portions per day.
- Consume a high proportion of high fibre foods such as wholemeal bread and other cereals
- Choose a variety of plant based foods such as cereals, legumes (such as lentils, beans and peas), starchy foods (such as pasta, rice and bread) as well fruit and vegetables
- Select foods low in fat and salt
- Drink alcohol in moderation if at all

These dietary changes as well as maintaining a healthy weight and being physically active can help reduce the risk of developing cancer.

The Committee on Medical Aspects of Food and Nutrition policy (COMA)<sup>4</sup> assembled a working party of experts to look at the evidence for the role of nutrition in cancer causation and to develop recommendations for the prevention of a number of common cancers. In addition to the above dietary recommendations they also suggested that red meat and processed meat consumption should not increase, instead choosing white meat and fish as alternatives

### **The benefits of tea**

There is increasing evidence that specific substances found in certain foods can enhance general healthy eating recommendations e.g. phenolic compounds found in plants. Tea is rich in specific phenolic compounds including flavonoids.

Animal and in-vitro studies have provided evidence that the polyphenols found in tea may have cancer preventative effects<sup>5,6,7</sup> Tea has been shown to inhibit tumorigenesis in many animal models, including those for cancer of the skin, lung, oral cavity, oesophagus, stomach, small intestine, colon, liver, pancreas, bladder, and prostate.<sup>8,9,10</sup> Suggested mechanisms of action have been reviewed in a number of papers<sup>11,12,13</sup> and include:

- Antioxidant activity and scavenging free radicals<sup>7,9,14,15,16,17</sup>
- Modulating enzymes implicated in the carcinogenic process<sup>10,18</sup>
- Modifying the pathways of signal transduction, thereby positively altering the expression of genes involved in cell proliferation, angiogenesis, and apoptosis, all important stages of cancer progression<sup>19,20</sup>
- Antimicrobial actions<sup>21,22</sup> (association between *Helicobacter pylori* and gastric cancer)

While the exact mechanisms of action are still unknown, these studies provide possible explanations. However, additional in-vivo studies are required, using tea in amounts that are typically consumed, to further evaluate any potential mechanisms in humans.

### **The evidence for tea and cancer**

A number of epidemiological studies suggest that tea drinking is associated with a decreased risk of cancer. For example, in a Japanese population survey, an overall protection together with a slowdown in increase of cancer incidence was reported with tea drinking.<sup>23</sup> The effects were more pronounced when the consumption rose to over 10 cups of tea a day. However, other epidemiological studies investigating the association between tea consumption and a reduced risk of cancer have been inconclusive:

#### Stomach Cancer

Some studies have shown an inverse association between green tea drinking and stomach cancer<sup>24,25,26,27,28,29,30,31,32,33</sup> one of which reported that green tea drinkers had a 48% reduced risk of developing stomach cancer and a 51% lower risk of developing chronic gastritis versus non drinkers.<sup>24</sup> However a recent review, conducted in 2005 by Hoshiyama,<sup>34</sup> examined the association between green tea consumption and stomach cancer in both case control and prospective studies. This review concluded that results from the prospective studies (considered to be more reliable than case controls) showed no benefit from drinking green tea on stomach cancer risk. Another review on this subject also concluded that from the current epidemiological evidence, green tea did not have a protective role in the prevention of stomach cancer; however it did suggest that there appears to be a protective effect of green tea on adenomatous polyps and chronic atrophic gastritis formations.<sup>35</sup>

### Breast cancer

A number of population studies have now investigated a potential link between tea drinking and protection against breast cancer.<sup>36,37,38,39</sup> A study in a Los Angeles County of tea drinkers showed a significantly reduced risk of breast cancer compared to non-tea drinkers.<sup>36</sup> It was observed that the risk of breast cancer was lowest among those who drank green tea only, intermediate among those who drank both green and black tea, and unchanged among those who drank black tea only.

Results from another study in Japan found that the regular consumption of green tea (more than 3 cups a day) might be protective against recurrence of breast cancer in the early stages.<sup>39</sup> This has been confirmed in a recent meta-analysis that reviewed all observational studies assessing breast cancer incidence and recurrence.<sup>40</sup> Results from this review indicated that green tea may possibly help prevent breast cancer recurrence in early stage (I and II) cancers, however, because of the small studies that have been conducted to date and the lack of any clinical trial evidence, it is difficult to draw any firm conclusions.

However a recent meta-analysis of all epidemiological studies that have examined the effect of both green tea and black tea on breast cancer risk, indicated that there may be a lower risk for green tea consumption, but the results for black tea were conflicting.<sup>41</sup> This is in contrast to a pooled analysis of two prospective studies in Japan that included over 35,000 Japanese women, which found green tea intake was not associated with a lower risk of breast cancer.<sup>42</sup>

### Lung Cancer

Flavonoids have also been associated with a reduced risk of lung cancer<sup>43</sup> and one case control study reported a 50% reduction in lung cancer risk when consuming 1 cup of black tea a day.<sup>44</sup> A population-based case-control study of women from the Shanghai Residential Registry found that among non-smoking women, consumption of green tea was associated with a reduced risk of lung

cancer, and the risks decreased with increasing consumption of green tea.<sup>45</sup> However, another study that investigated the relationship between catechin intake (a type of flavonoid that is abundant in tea) and lung cancer, found no such association<sup>46</sup>. Other studies investigating the relationship between tea drinking/ flavonoids and lung cancer also reported no association.<sup>47,48,49,50</sup>

### Ovarian cancer

A case control study in China during 1990-2000 found that increasing the frequency of tea drinking, especially green tea, can help reduce the risk of ovarian cancer.<sup>51</sup>

A more recent study, conducted by researchers at the National Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden, examined the association between tea consumption and risk of ovarian cancer in 61,057 women, aged 40 to 76 years, who were participants in the population-based Swedish Mammography Cohort. During 15 years of follow up a 46% lower risk of ovarian cancer was found in women who drank two or more cups of tea per day compared with non tea drinkers Each additional cup of tea was associated with an 18% decreased risk of ovarian cancer.<sup>52</sup>

### Prostate Cancer

It has been reported that drinking 6 cups of green tea per day significantly inhibits prostate cancer development and metastasis.<sup>53</sup> A case-control study, conducted in Southeast China during 2001-2002, found that prostate cancer risk decreased with increasing frequency, duration and quantity of green tea consumed.<sup>54</sup>

Inconsistencies from these population studies maybe as a result of their design e.g. lack of detail about exposure to tea – quantity, strength and variety, insufficient information about the flavonoid contents of foods, variation of flavonoid content amongst food varieties, discrepancies in the collation of dietary information using dietary analysis questionnaires and confounding lifestyle and environmental factors. These details may influence the end results and make them difficult to interpret. Consideration of these factors is required for any future research.

### **In summary...**

Tea and flavonoids have been identified as potential cancer preventatitive components in animal and in vitro studies. However, the inconclusive results reported in population studies maybe as a result of a number of confounding factors making the results difficult to interpret. Although the scientific evidence for tea is growing, it is not yet conclusive and represents a promising area for future research. In the mean time, it is reasonable to conclude that drinking both green and black tea is compatible with healthy eating dietary advice to help reduce the risk of developing cancer, helping to maintain overall health and well-being.

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