



International Journal of Autism

E-ISSN: 2710-3927
P-ISSN: 2710-3919
IJRSE 2024; 4(1): 11-19
© 2024 IJA
www.rehabilitationjournals.com
Received: 07-11-2023
Accepted: 11-12-2023

Luke Curtis
MD, Adjunct Professor, Public
Health, East Carolina
University, Greenville, South
Carolina, USA

Autistic men have many risk factors for prostate cancer, more clinical attention and research are needed to prevent and treat prostate cancer in autistic men, autistic males need to eat more fruits and vegetables

Luke Curtis

DOI: <https://doi.org/10.22271/27103919.2024.v4.i1a.30>

Abstract

Background: Prostate cancer kills about 34,700 men annually in the USA and will affect more than 1 in 8 men in their lifetime. Epidemiological studies of prostate cancer in autistic men are currently lacking.

Methods: This is a narrative review conducted by searching three databases.

Results: Autistic men seem to be at especially high risk for prostate cancer for several reasons.

1. Poor diet which is often lacking or very low in fruit and vegetables.
2. Relative lack of medical care including low rates of prostate specific antigen (PSA) testing
3. Low levels of sexual activity.
4. Other demographic factors related to higher prostate cancer levels such as low income, unemployment, non-married status, and chemical exposures.

Conclusions: Prostate cancer prevention and early diagnosis and treatment are critical for reducing prostate cancer morbidity and mortality in autistic male populations. It is especially important to encourage autistic people to eat at least 5 servings, and preferably 10 servings, of a wide range of fruits and vegetables daily. Several large and statistically robust meta-analyses have reported that frequent consumption of foods such as tomatoes, watermelon, cruciferous vegetables, onion family vegetables, and soy have been linked to significantly lower rates of prostate cancer. Further research and clinical attention for prevention and early diagnosis/ treatment of prostate and other cancers are clearly needed in autistic populations.

Keywords: Autism, prostate cancer, cancer, tomato, broccoli, onion, soy, PSA, sexual activity

Introduction

Prostate Cancer Very Common and Causes Tremendous Morbidity and Mortality

Prostate cancer is a very common male cancer which is estimated to cause 288,300 new cases and 34,700 deaths in 2023 in the USA alone. It is estimated that more than 1 in 8 (12.6%) USA men will get prostate cancer in their lifetime ^[1]. Prostate cancer causes enormous problems for affected men including chronic pain, incontinence, erectile dysfunction, relationship problems, severe depression, severe anxiety, and significantly increased suicide risk ^[2-6].

Methods

This study is a narrative literature review of published peer reviewed articles which were available by November 23, 2023. The Pub Med, EMBASE, and Google Scholar databases were searched for relevant articles for such topics as prostate cancer, cancer in general, autism and related disabilities, diet, fruits, vegetables, individual foods such as broccoli, tomatoes, watermelon, onion, soy, phytochemicals, food supplements, PSA testing, sexual activity, marital status, poverty, unemployment, smoking, and environmental exposures. Every effort was made to collect and select all relevant articles and to try to get a balanced overview of the literature.

Correspondence

Luke Curtis
MD, Adjunct Professor, Public
Health, East Carolina
University, Greenville, South
Carolina, USA

Results

Most, But Not All, Studies Report Cancer More Common in Autistic Subjects Versus Neurotypicals

In 2018, US autism prevalence was about 2.3% in children aged 8 years and about 2.2% in adults [7]. Although published studies on overall cancer rates in autistic populations are sparse, the data gives conflicting results, with several studies linking autism to significantly higher cancer rates and other studies linking autism to significantly lower cancer rates as compared to the general population [8-10]. A Taiwan study of 8, 438 autistic children/ adolescents/ young adults reported cancer in autistic subjects to be about 1.94 times as great as expected for a matched population (RR 1.94, 95% CI 1.18-2.99) [11]. A California study of 13,111 ambulatory Californians with autism reported that cancer deaths rates were 1.9 times as great in autistic subjects with little or no intellectual disability and 2.9 times as great in autistic subjects with moderate to severe disability [12].

A study of 2.3 million Swedish children (Followed up to 30 years of age) reported that autistic subjects had significantly elevated cancer rates relative to the standard population (OR 1.3 95% CI 1.2-1.5), however, the sub group of autistic patients without intellectual disability had cancer mortality rates similar to the general population (OR 1.0, 95% CI 0.8-1.2) [13].

Another study has reported significantly lower overall rates of cancer in male and female autistic populations (Especially in childhood) [14]. This epidemiological study of 1,837 people with autism spectrum disorder reported that the cancer odds ratios of autistic patients versus controls was only 0.06 for those in the 0 to 14 age group (Males and females), which rose to 0.95 among males over age 55 years [14]. A study of US Medicare patients aged 65+ years reported that cancer rates were 20% significantly higher in a group of 1,440 autistic patients as compared to 46,850 matched population controls (adjusted OR 1.2, 95% CI 1.2-1.3) [15].

Some studies have reported that some genetic mutations, signaling pathways, and enzymes seem to play a role in both autism and cancer-including the ARD D1B gene which has been implicated in prostate cancer [8, 16].

Autistic Men Have Several Risk Factors for High Prostate Cancer Rates

I was not able to locate specific epidemiological data reporting prostate cancer rates in autistic men. One 2014 systematic review of 50 published studies linking cancer rates in populations with central nervous system disorders (Including Alzheimer's, amyotrophic lateral sclerosis, autism, Down's syndrome, Huntington's disease, multiple sclerosis, and schizophrenia) was able to locate only one study involving autistic patients-(With brain cancer) [17]. However, autistic men have many life style factors which make them more susceptible than average to the all too common disease of prostate cancer. Such factors include a low quality and low variety diet lacking in fruits and vegetables, low levels of medical exams and prostate cancer surveillance, relatively low rates of sexual activity, low marriage rates, poverty, unemployment, and racial disadvantages. These potential risk factors will be discussed in the following sections.

Fruit and Vegetable Rich Diets Significantly Reduce Risk of Cancer, but Relatively Few People Consume the Recommended Quantities of Fruits and Vegetables

Many studies have reported that consumption of 5 or more servings a day of fruits and vegetables (1/2 cup or 80 gm. servings) are associated with significantly lower mortality rates from cancer, heart disease, and respiratory disorders. For example, two huge US prospective studies with 67,719 women and 42,016 men reported that consumption of 5 servings a day of fruits and vegetables as compared to 2 servings per day was associated with a 13% reduced risk of total mortality (Odd Ratio = OR 0.87, 95% CI 0.85-0.90), a 10% reduced risk of cancer mortality (OR 0.90, 95% CI 0.86-0.95), a 12% reduced risk of cardiovascular mortality (OR 0.88, 95% CI 0.83-0.94), and a 35% reduced risk of respiratory disease mortality (OR 0.65, 95% CI 0.59-0.72) [18].

Both the USA Dietary Guidelines and The American Cancer Society recommend eating at least 8 to 10 half cup servings of a wide range of fruits and vegetables daily [19].

Relatively few children and adults eat the recommended levels of fruits and vegetables. For example, a 2019 US nationally representative survey of 294,566 adults reported that median vegetable consumption was only 1.0 serving a day and median fruit consumption was only 1.6 servings a day [20].

Poor Quality, Monotonous Diets with Low Levels of Vegetables and Fruits Are Very Common in Children and Adults with Autism and Related Developmental Disabilities

Many autistic children and adults consume diets lacking in variety and having low levels of fruits and vegetables, although published data is fairly sparse. Some studies have reported that about 70% of autistic children have atypical eating disorders and many studies have reported that food selectivity and a limited number of tolerated foods are common in autism [21, 22].

A study of 48 children with intellectual disabilities (including many with autistic spectrum disorder) reported mean total vegetable consumption was very low at an average of 0.55 servings a day compared to 1.23 daily servings in 55 healthy children ($p < 0.001$) [23]. A 3-day food record study of children aged 3 to 11 years reported that 16 of 48 (33%) autistic children consumed no vegetable in the last 3 days as compared to 2 out of 54 (4%) in typically developing children ($p < 0.001$) [24].

A related study reported that 53 autism spectrum children ate significantly fewer fruit and vegetable servings than 58 normally developing children (Mean of 3.1 vs. 4.4 servings day, $p = 0.006$) [25].

Caretaker reports from 70 autism spectrum children diagnosed with severe food selectivity reported that 47 children (67.1%) omitted all vegetables entirely and 19 children (27.1%) omitted all fruits entirely [26]! Inadequate intake of many nutrients was common in this group of 70 children, with 67.1% (Over two thirds) of the children consuming less than 80% of the daily reference intake of 6 or more of the following 12 nutrients: energy, protein vitamins A, B-12, C, D, and E, folate, calcium, iron, zinc, and fiber.

A large prospective study of 5,553 children aged to 2 to 5 years old reported that low vegetable consumption was quite common, with 1,581 children (28.5%) having parental

reported vegetables consumption of 0.5 of fewer vegetable servings per day [27]. A study of 38 autistic children with an average age of 8.7 years reported that mean daily consumption of fruits was 1.15 servings per day and vegetables was 1.02 servings per day [28]. A Chilean study of 72 autistic children reported that 93.06% and 62.50%, respectively did not consume enough vegetables and fruits to meet dietary guidelines [29]. A Spanish study of 117 children with ASD and 333 typically developing children reported vegetable and fruit consumption were not significantly different [30].

A few studies have reported that autistic adults often have low daily intakes of fruits and vegetables. A recent large British study reported that 746 adult autistic women had significantly much lower rates of meeting the 5 servings a day fruit-and vegetable intake as compared to the general population (OR 0.550, 95% CI 0.448, 0.676, $p=0.0000003$), and 437 autistic men had similar (relatively low) rates of meeting the 5 serving a day of fruit and vegetable intake about often (OR 1.075, 95% CI 0.808, 1.430, $p=0.625$ as compared to the general UK population [31].

A survey of 920 British adults with intellectual disability, many with autism spectrum disorders, reported that 29.4% had a very low fruit and vegetable intake of less than 5 servings a week or 0.71 portions per day [32]. An Australian study of 33 adults with intellectual disability [33] living in group homes reported that mean daily levels of vegetable were 2.4 servings (80 gr) a day for men and 2.3 for women, which are well below the Australian Guide to Healthy Eating standards of 5.5 servings day for men and 5.0 servings day for women [34]. Fruit consumption was also low and averaged only 1.5 servings a day for men and 1.1 servings day for women, well below the Australian standard of at least 2 fruit servings a day [34].

Some phytochemicals such as sulforaphane (found in cruciferous vegetables like broccoli) have a wide range of anti-inflammatory, anti-cancer, and positive neuromodulatory effects [35]. Some studies have reported that eating sulforaphane rich broccoli sprouts was associated with significantly reduced autistic symptoms in 16 autistic males in their teens and twenties [36].

The diets of some autistic subjects are so low in fruits and vegetables (The main sources of vitamin A and C) that they can exhibit symptoms of severe deficiencies of vitamin A and C that are rarely seen in non-impooverished populations. More than 10 case studies have been presented of autistic children who ate a diet lacking or very low in fruits and vegetables, and who developed both severe vitamin A deficiency and irreversible partial or total loss of vision [39-39]. Another review reported 24 autistic children who developed severe deficiency of vitamin C or scurvy following a diet lacking or very low in fruits and vegetables [40].

More studies on the diets in autistic people of all ages and interventions to greatly increase fruit and vegetable consumption and improve their diets in general are warranted.

Relatively High Levels of Fruit, Vegetable, Soy, and Phytochemical Consumption Significantly Cut Prostate Cancer Risk

Many clinical and epidemiological studies have reported that frequent consumption of many different fruits and vegetables and their associated phytonutrients (Sometimes

called phytochemicals if they have positive health effects) are associated with significantly lower prostate cancer risk [41]. The fruit and vegetable rich Mediterranean diet has also been associated with significantly lower risk of prostate cancer [42]. Other studies have reported that consumption of phytonutrients such as lycopene (Found in tomatoes and watermelon), broccoli sprouts (Rich in sulforaphane), pomegranate juice, soy isoflavones, grape seed extracts, and curcumin in either food or supplements are also associated with significantly lower prostate cancer risk [43-48]. At least 50 phytonutrients which have probable or possible effects against prostate cancer have been described [43]. Since many of these phytonutrients are believed to have synergistic effects, it may be beneficial to consume a number of phytonutrients (In food or supplements) at the same time [43, 49]. For a good diagram with proposed mechanisms about how phytochemicals probably reduce risk of prostate cancer, please consult Figure 2 of Page 18 of Hao 2022 [43]. There are at least 4 groups of vegetables, fruits, and soy for which large, robust, and statistically significant and robust meta-analyses have reported that relatively high levels of consumption are associated with significantly less prostate cancer rates as compared to lower rates of consumption. These 4 food groups and results of these fairly large meta analyses are shown in table 1 [50].

- 1. Tomato Products:** High consumption is associated with a 16% reduced risk of prostate cancer OR 0.84, 95% CI of 0.72-0.95, 30 Studies. (Please note: Tomatoes and Watermelons are both excellent sources of lycopene) [50].
- 2. Cruciferous Vegetables:** Broccoli, Cabbage, Brussels sprouts, Cauliflower, Radish, Arugula, Bok Choi etc. High consumption is associated with a 21% reduced risk of prostate cancer OR 0.79, 95% CI 0.69-0.89 13 studies [51].
- 3. Onion or Allium Family:** (Onions, Shallots, Leeks, Chives, Garlic. etc.). High consumption is related to a 18% reduced risk of prostate cancer OR 0.82, 95% CI 0.70-0.97, 9 studies [52].
- 4. Soy Protein Products:** Tofu, Roasted Soy Nuts, Edamame, Isolated Soy Protein etc. High consumption is related to a 31% reduced risk of prostate cancer OR 0.69, 95% CI 0.57-0.84, 13 studies [53].

While the human epidemiological data strongly suggests that higher consumption of the 4 groups of vegetables/ fruits/ legumes listed above (i.e. tomatoes, cruciferous vegetables, onion family, and soy) are linked with significantly lower prostate cancer rates, the evidence linking dietary patterns or other foods with lower prostate cancer rates is less clear. Meta-analysis of 6 studies reported that high adherence to the Mediterranean Diet (Rich in fruits, vegetables, fish, and olive oil) was associated with a small, but statistical significant reduction in prostate cancer rates (RR observation = 0.96, 95% CI 0.92-1.00) [54]. Another meta-analysis of 17 published studies reported that relatively high fruit and vegetable consumption versus relative low consumption was not associated with significantly different prostate cancer rates-for high vegetable consumption (RR=0.98, 95% CI 0.94-1.02) and for high fruit consumption (RR=1.00, 95% CI 0.94-1.05) [55].

Avoiding Trans Fats and Refined Sugar Useful. Foods like trans fats and refined sugars should be avoided or limited.

Meta-analyses have reported that high consumption of trans fats (11 studies, OR 1.49, 95% CI 1.13-1.95)^[56] and sugar sweetened beverages (5 studies, OR 1.10, 95% CI 1.00-1.22)^[57] are associated with significantly higher prostate cancer rates.

A summary of large meta-analyses comparing prostate cancer rates with high versus low consumption of various foods and diet patterns are listed in Table 1 Below.

Insert Table 1 Below

Relatively Low Rates of Medical Care and Cancer Screening in Autistic and Other Developmentally disabled populations

Lack of routine medical visits and screening tests such as prostate specific antigen (PSA) testing and routine maintenance visits may increase the risk of autistic patient's not receiving care to prevent or diagnose prostate and other cancers early^[58]. Surveys have suggested that autistic patients may receive fewer frequencies of routine medical office visits as well as visits for acute illness^[59]. Many autistic patients have difficulties in recognizing adverse physical signs and symptoms, may fail to report them to medical professionals, and may also fail to appreciate the need to schedule and keep medical appointments^[59].

Prostate specific antigen (PSA) screening is frequently recommended for middle aged and men over 50 years old^[60]. However, the benefits of regular prostate screening may be fairly modest and not always statistically significant. A meta-analysis of 5 prospective studies involving 721,718 men, reported the regular PSA blood antigen screening was associated with only a small drop in relative mortality (IRR 0.96, 95% CI 0.85 to 1.08)^[61].

One British study reported that in a cohort of patients with intellectual disabilities (ID- including many with autism), routine health screening was significantly less common in the autistic population including Prostate Antigen Screening (PSA) (3,520 eligible patients, Incidence Rate Ratio= IRR 0.87, 95% CI 0.60-0.96), fecal occult blood sampling (6,566 eligible patients, IRR 0.86 IRR 0.78-0.94), and mammograms (2,956 eligible patients, IRR 0.76, 95% CI 0.72-0.81)^[62]. A US nationally representative study reported that PSA testing was significantly less common among 782 men with disabilities (median age 65 years) as compared to 4, 569 control men without disabilities (OR 0.77, 95% CI 0.62-0.96, $p=0.018$)^[58]. On the other hand, a California study of males over age 40 reported that PDS prostate cancer screening was slightly more common in autistic spectrum disorder (ASD) versus the general population (OR 1.2, 95% CI 0.8-1.8, populations had 1,507 autistics versus 15,070 from the general practice)^[63].

Relatively Low Rates of Sexual Activity

The apparently lower rates of sexual activity seen in autistic men also may be a significant factor in their likely increased risk for prostate cancer. Most studies have reported that autistic adolescents and adults have many social problems associated with sexuality and development of sexual relationships, and have significantly lower rates of sexual activity and significantly higher rates of asexuality and LGBTQ orientation as compared to typically developing populations^[64-67]. A large study of 2, 386 British adults aged 16 years or older included 738 autistic women, 819 aged matched women, 436 autistic men, and 371 aged matched control men⁶⁴. The risk of never having had

partnered sex was significantly higher in the autistic group versus the control group for both females and males^[64]. For females, 76.02% of the autistic females had ever been sexually active versus 88.77% for the control females- OR 0.482, 95% CI 0.303- 0.768, $p = 0.002$. For males, 70.18% of the autistic males had ever been sexually active versus 88.95% of the control males- OR 0.239, 95% CI 0.124-0.458, $p = 0.002$ ^[64]. A small survey reported higher levels of sexual experience in 39 typically developing young adults as compared to 21 high functioning autistic young adults^[68]. Some studies have reported that regular sexual activity is associated with significantly lower rates of prostate cancer. A meta-analysis of 21 case-control and 1 cohort study involving 55,490 men reported that having ejaculatory sex 2 to 4 times a week was associated with significantly lower rates of prostate cancer (OR 0.91, 95% CI 0.87-0.96)^[69]. A large prospective study of 31,925 men over 20 years old, reported that a covariate adjusted analysis found that having ejaculation frequency of 21+ times a month as compared to 4 to 7 times per month was associated with 22% lower risk of prostate cancer (OR 0.78, 95% CI 0.69-0.89, $p < 0.0001$)^[70].

A July 2023 Spanish CAPLIFE study of 456 histologically confirmed prostate cancer cases and 427 control men aged 40 to 80 years old that having ejaculations more than 4 times per month were associated with significantly lower rates of prostate cancer and significantly lower rates of metastatic prostate cancer^[71]. Compared to men having more than 4 ejaculations per month-in the past year, men who ejaculated 0 to 3 times per month had more than a doubled risk of prostate cancer (Adjusted OR = 2.38, 95% CI 1.57-3.60) and a more than 4 fold risk of metastatic prostate cancer (OR 4.70, 95% CI 1.55-14.29)^[71]:

Some studies have reported that autistic men have significantly greater levels of erectile dysfunction as compared to neurotypical men^[72]. The use of phosphodiesterase inhibitor 5 drugs such as 1. Sildenafil or Viagra®, 2. Tadalafil or Cialis®, and 3. vardenafil or Levitra®- have been associated with: 1. significantly better sexual function, 2. significantly lower rates of prostate cancer incidence, and 3. significantly lower overall mortality rates^[73, 74]. For example, a 7-year long study of 2, 632 men with erectile dysfunction reported that the risk of developing prostate cancer was about 60% lower in men taking the phosphodiesterase 5 inhibitor drugs as compared to men not taking these drugs (Adjusted OR 0.39, 95% CI 0.40-0.60, $p < 0.0001$). A retrospective study of 72, 498 men with erectile dysfunction reported that the use of the phosphodiesterase 5 inhibitor erectile function drugs were associated with significantly lower cardiovascular death rates (Hazard Ratio = 0.61, 95% CI 0.41-0.90, $p=0.014$) and significantly lower rates of overall mortality (HR 0.75, 95% CI 0.65-0.87, $p < 0.001$)^[73]. The significantly lower prostate cancer and mortality could be due to: 1) the many beneficial physiological effects of the phosphodiesterase drugs, 2) the beneficial effects of more and better sexual activity, or 3) a combination of these 2 effects^[73].

On the other hand, numerous studies have reported that sexually transmitted diseases are associated with significantly higher prostate cancer rates. A 2002 meta-analysis reported that a history of any sexually transmitted diseases (s) was associated with significantly higher rates of prostate cancer (OR 1.44, 95% CI 1.19- 1.74, 17 studies) and especially increased in case of syphilis infections (OR 2.30,

95% CI 1.34-3.94, 6 studies) [75].

Most autistic men need to be counseled in dating and relationships skills in general as well as safe sex practices such as used of condoms and other forms of birth control, limiting the number of sexual partners, and testing/treatment for sexually acquired infections, A number of recent publications have addressed the relative lack of and the need for more and better relationship and sexuality education in autistic adolescents and adults as well as the need for more relationship and sexuality education in neurodivergent people [67, 76-82].

Other Factors- Race, Poverty, Unemployment, and Chemical Exposures: Other social factors such as race, poverty, unemployment and lack of marriage / partner status often seen in autistic patients are also associated with significantly increased prostate cancer morbidity and mortality [83, 84]. A number of environmental factors including tobacco smoking, higher outdoor levels of particulates smaller than 2.5 µm (PM2.5) and nitrogen dioxide (NO2), and exposures to toxic chemicals such as wildfire smoke, pesticides, exposures to solvents such as benzene, toluene and xylene, and metals such as cadmium and arsenic have been associated with significantly higher rates of prostate cancer [85-92].

Table 1: Summary of Published Meta-Analyses Which Examine Relationships of Relatively High Versus Relatively Low Consumption of Various Foods and Diet and Relative Risk of Prostate Cancer

Food or Diet	Number of Published Studies	Odds Ratio (OR) or Relative Risk (RR) and 95% Confidence Interval (CI)	Meta-Analysis Reference
Tomato Products	30	OR= 0.84, 95% CI 0.72-0.95	(Xu <i>et al.</i> 2016) [50]
Cruciferous Vegetables	13	OR= 0.79, 95% CI 0.69-0.89	(Liu <i>et al.</i> 2012) [51]
Onion or Allium Family	9	OR= 0.82, 95% CI 0.70-0.97	(Zhou <i>et al.</i> 2013) [52]
Soy Products	13	OR= 0.69, 95% CI 0.57-0.84	(Hwang <i>et al.</i> 2009) [53]
Mediterranean Diet High Adherence	6	RR= 0.96, 95% CI 0.92-1.00	(Schwingshackl <i>et al.</i> 2017) [54]
High Vegetable Diet	17	RR= 0.98, 95% CI 0.94-1.02	(Yan <i>et al.</i> 2022) [55]
High Fruit Diet	17	RR= 1.00, 95% CI 0.94-1.05	(Yan <i>et al.</i> 2022) [55]
Trans Fats	11	OR= 1.49, 95% CI 1.13-1.95	(Michels <i>et al.</i> 2021) [56]
Sugar Sweetened Beverages	5	OR= 1.10, 95% CI 1.00-1.22	(Pan <i>et al.</i> 2023) [57]

Discussion and Conclusion

Although epidemiological studies are currently lacking, it appears that autistic men have many risk factors which would make them very susceptible to prostate cancer. One limitation of this review is the current relative scarcity of studies of cancer and diet in autistic populations [93]. More research and clinical attention of nutrition, medical care, and emotional/ social/ relationship support are needed in older autistic populations to reduce incidence of cancer and diseases [10, 15, 94].

Much can be done to get autistic men to get better diets, better medical care, and appropriate intimate relationships. Autistic people should be encouraged to consume a varied and broad based diet including sufficient water and other liquids, 10+ servings a day of a wide range of fruits and vegetables, whole grains, nuts, soy products like tofu, soy nuts or soy protein plus dairy products, meat, and fish in moderation. Fruits and vegetables with documented strong anti-cancer properties such as: 1. Tomatoes and Watermelon (For lycopene), 2. Cruciferous vegetables (Broccoli, Cabbage, Cauliflower, Radish. Arugula, Bok Choi), 3. Onion or Allium Family (Onions, Garlic, Leeks, Shallots, Chives, etc.), and 4. Soy Protein Products should be consumed daily. Intake of foods such as trans fats sugar, corn syrup, honey, and white flour/ rice should be minimized.

Food allergies are more common in autistic people as compared to the general population. A meta-analysis of 12 published studies involving 434,809 subjects observed a strong positive association between food allergies and risk of autistic spectrum disorder (OR = 2.792, 95% CI 2.081-3.746) [95]. Some common foods like gluten (Wheat, rye, barley), soy, and cow’s milk may need to be avoided if the subject has problems with food allergies or sensitivities.

Consumption of high levels of fruits and vegetables will not only reduce risk of prostate cancer, breast cancer, and other

cancers, as well as risk of cardiovascular and respiratory disease. Effective strategies need to be developed to get autistic children and adults to eat more vegetables and fruits. Various studies with children have reported that interventions such as providing more varied selections of fruit and vegetables, parental and child nutritional education, and gardening interventions can increase fruit and vegetable consumption [96, 97]. Assistance and/or coaching in shopping and cooking delicious and nutritious fruit/ vegetable rich meals should be provided to autistic children and adults with lower levels of functioning so they don’t have to rely on a less nutritious- fruit/ vegetable poor diet of fast food, TV dinners, sugary colas, sweets, and snack foods. In addition, social and meal preparation factors such as eating together with congenial people, proper seating and lighting, and using attractive plates and tableware can also improve nutritional intake [22].

Autistic men should be given regular medical exams and regular prostate specific antigen (PSA) testing when indicated. If prostate cancer is suspected, they should receive additional tests such as MRI scans, prostate biopsies, and other useful prostate cancer related biopsy tests such as the Oncotype DX®, Prolaris®, and Decipher® tests [98]. Autistic men should be encouraged and supported in developing safe/ healthy emotionally and sexually intimate relationships (except perhaps in some asexual autistic people). Smoking should be avoided and chemical exposures minimized.

In addition, counselors, physicians, nurses, teachers and other people who work with autistic people should be well informed on such topics as nutrition, cancer prevention, and preventive health maintenance for autistic people.

Acknowledgments

This study received no funding. I am thankful for all of the researchers and patients involved in the interesting studies I cite.

Declaration of Conflicting Interests: The author declares no potential conflict of interest.

Funding

The author received no financial support for this research, authorship, and publication.

References

1. Siegel RL, Miller KD, Wagle NS, Jemal A. Cancer statistics, 2023. *CA: A cancer journal for clinicians*. 2023;73(1):17-48.
2. Houédé N, Rébillard X, Bouvet S, *et al*. Impact on quality of life 3 years after diagnosis of prostate cancer patients below 75 at diagnosis: an observational case-control study. *BMC Cancer*. 2020;20(1):757.
3. Sharpley CF, Christie DRH, Bitsika V. Depression and prostate cancer: implications for urologists and oncologists. *Nature reviews Urology*. 2020;17(10):571-585.
4. Klaassen Z, Arora K, Wilson SN, *et al*. Decreasing suicide risk among patients with prostate cancer: Implications for depression, erectile dysfunction, and suicidal ideation screening. *Urologic oncology*. 2018;36(2):60-66.
5. Chung E, Gillman M. Prostate cancer survivorship: A review of erectile dysfunction and penile rehabilitation after prostate cancer therapy. *The Medical journal of Australia*. 2014;200(10):582-585.
6. Mirza M, Griebing TL, Kazer MW. Erectile dysfunction and urinary incontinence after prostate cancer treatment. *Seminars in oncology nursing*. 2011;27(4):278-289.
7. Hirota T, King BH. Autism Spectrum Disorder: A Review. *Jama*. 2023;329(2):157-168.
8. Wen Y, Herbert MR. Connecting the dots: Overlaps between autism and cancer suggest possible common mechanisms regarding signaling pathways related to metabolic alterations. *Med Hypotheses*. 2017;103:118-123.
9. Crespi B. Autism and cancer risk. *Autism research: official journal of the International Society for Autism Research*. 2011;4(4):302-310.
10. Freitas Ramos S, Moura B, Corvacho M, Tavares A. Caring for People with Autism Spectrum Disorder and Cancer. *Acta medica portuguesa*. 2022;35(4):309-310.
11. Chiang HL, Liu CJ, Hu YW, *et al*. Risk of cancer in children, adolescents, and young adults with autistic disorder. *J Pediatr*. 2015;166(2):418-423.e411.
12. Shavelle RM, Strauss DJ, Pickett J. Causes of death in autism. *J Autism Dev Disord*. 2001;31(6):569-576.
13. Liu Q, Yin W, Meijssen JJ, *et al*. Cancer risk in individuals with autism spectrum disorder. *Annals of oncology: official journal of the European Society for Medical Oncology / ESMO*. 2022;33(7):713-719.
14. Darbro BW, Singh R, Zimmerman MB, Mahajan VB, Bassuk AG. Autism Linked to Increased Oncogene Mutations but Decreased Cancer Rate. *PLoS One*. 2016;11(3):e0149041.
15. Hand BN, Angell AM, Harris L, Carpenter LA. Prevalence of physical and mental health conditions in Medicare-enrolled, autistic older adults. *Autism: the international journal of research and practice*. 2020;24(3):755-764.
16. Crawley JN, Heyer WD, LaSalle JM. Autism and Cancer Share Risk Genes, Pathways, and Drug Targets. *Trends in genetics: TIG*. 2016;32(3):139-146.
17. Catalá-López F, Suárez-Pinilla M, Suárez-Pinilla P, *et al*. Inverse and direct cancer comorbidity in people with central nervous system disorders: A meta-analysis of cancer incidence in 577, 013 participants of 50 observational studies. *Psychother Psychosom*. 2014;83(2):89-105.
18. Wang DD, Li Y, Bhupathiraju SN, *et al*. Fruit and Vegetable Intake and Mortality: Results from 2 Prospective Cohort Studies of US Men and Women and a Meta-Analysis of 26 Cohort Studies. *Circulation*. 2021;143(17):1642-1654.
19. Rock CL, Thomson C, Gansler T, *et al*. American Cancer Society guideline for diet and physical activity for cancer prevention. *CA: A cancer journal for clinicians*. 2020;70(4):245-271.
20. Lee SH, Moore LV, Park S, Harris DM, Blanck HM. Adults Meeting Fruit and Vegetable Intake Recommendations - United States, 2019. *MMWR Morbidity and mortality weekly report*. 2022;71(1):1-9.
21. Marí-Bauset S, Zazpe I, Mari-Sanchis A, Llopis-González A, Morales-Suárez-Varela M. Food selectivity in autism spectrum disorders: a systematic review. *J Child Neurol*. 2014;29(11):1554-1561.
22. Conti MV, Breda C, Basilico S, *et al*. Dietary recommendations to customize canteen menus according to the nutritional and sensory needs of individuals with autism spectrum disorder. *Eating and weight disorders: EWD*. 2023;28(1):66.
23. Bandini LG, Curtin C, Phillips SM, *et al*. Nutrient adequacy, dietary patterns and diet quality among children with and without intellectual disabilities. *Journal of intellectual disability research: JIDR*. 2021;65(10):898-911.
24. Swartz AP, Phillips S, Truexm L, Weems L, Must A, Bandini L. Dietary Absence of Fruits and Vegetables over a 3-day period: An analysis comparing children with autistic spectrum disorder (ASD) and typically developing disorder. *Journal of the Academy of Nutrition and Dietetics*. 2016;116(9):A-76.
25. Evans EW, Must A, Anderson SE, *et al*. Dietary Patterns and Body Mass Index in Children with Autism and Typically Developing Children. *Research in autism spectrum disorders*. 2012;6(1):399-405.
26. Sharp WG, Berry RC, McCracken C, *et al*. Feeding problems and nutrient intake in children with autism spectrum disorders: a meta-analysis and comprehensive review of the literature. *J Autism Dev Disord*. 2013;43(9):2159-2173.
27. Acosta A, Khokhlovich E, Reis H, Vyshedskiy A. Dietary Factors Impact Developmental Trajectories in Young Autistic Children. *J Autism Dev Disord*; c2023.
28. Kral TVE, O'Malley L, Johnson K, *et al*. Effects of a mobile health nutrition intervention on dietary intake in children who have autism spectrum disorder. *Frontiers in pediatrics*. 2023;11:1100436.
29. Ahumada D, Guzmán B, Rebolledo S, *et al*. Eating Patterns in Children with Autism Spectrum Disorder. *Healthcare (Basel, Switzerland)*. 2022, 10(10).
30. Canals-Sans J, Esteban-Figuerola P, Morales-Hidalgo P, Arija V. Do Children with Autism Spectrum Disorders Eat Differently and Less Adequately than Those with Subclinical ASD and Typical

- Development? EPINED Epidemiological Study. *J Autism Dev Disord.* 2022;52(1):361-375.
31. Weir E, Allison C, Ong KK, Baron-Cohen S. An investigation of the diet, exercise, sleep, BMI, and health outcomes of autistic adults. *Molecular autism.* 2021;12(1):31.
 32. Tyrer F, Dunkley AJ, Singh J, *et al.* Multimorbidity and lifestyle factors among adults with intellectual disabilities: a cross-sectional analysis of a UK cohort. *Journal of intellectual disability research: JIDR.* 2019;63(3):255-265.
 33. Antonio L, Wu FCW, Moors H, *et al.* Erectile dysfunction predicts mortality in middle-aged and older men independent of their sex steroid status. *Age and ageing.* 2022, 51(4).
 34. Hamzaid NH, O'Connor HT, Flood VM. Observed Dietary Intake in Adults with Intellectual Disability Living in Group Homes. *Nutrients.* 2019, 12(1).
 35. Yagishita Y, Fahey JW, Dinkova-Kostova AT, Kensler TW. Broccoli or Sulforaphane: Is It the Source or Dose That Matters? *Molecules (Basel, Switzerland).* 2019, 24(19).
 36. Lynch R, Diggins EL, Connors SL, *et al.* Sulforaphane from Broccoli Reduces Symptoms of Autism: A Follow-up Case Series from a Randomized Double-blind Study. *Global advances in health and medicine: improving healthcare outcomes worldwide.* 2017;6:2164957x17735826.
 37. Adachi S, Torio M, Okuzono S, *et al.* Vitamin A deficiency-associated corneal perforation in a boy with autism spectrum disorder: A case report and literature review. *Nutrition.* 2021;90:111275.
 38. Schimansky S, Jasim H, Pope L, *et al.* Nutritional blindness from avoidant-restrictive food intake disorder - recommendations for the early diagnosis and multidisciplinary management of children at risk from restrictive eating. *Archives of disease in childhood; c2023.*
 39. Song A, Mousa HM, Soifer M, Perez VL. Recognizing vitamin A deficiency: Special considerations in low-prevalence areas. *Current opinion in pediatrics.* 2022;34(2):241-247.
 40. Sharp WG, Berry RC, Burrell L, Scahill L, McElhanon BO. Scurvy as a Sequela of Avoidant-Restrictive Food Intake Disorder in Autism: A Systematic Review. *J Dev Behav Pediatr.* 2020;41(5):397-405.
 41. Cicero AFG, Allkanjari O, Busetto GM, *et al.* Nutraceutical treatment and prevention of benign prostatic hyperplasia and prostate cancer. *Archivio italiano di urologia, andrologia: organo ufficiale [di] Societa italiana di ecografia urologica e nefrologica/ Associazione ricerche in urologia.* 2019, 91(3).
 42. Capurso A, Capurso C. The Mediterranean way: why elderly people should eat wholewheat sourdough bread- a little known component of the Mediterranean diet and healthy food for elderly adults. *Aging clinical and experimental research; c2019.*
 43. Hao Q, Wu Y, Vadgama JV, Wang P. Phytochemicals in Inhibition of Prostate Cancer: Evidence from Molecular Mechanisms Studies. *Biomolecules.* 2022, 12(9).
 44. Van Die MD, Bone KM, Emery J, Williams SG, Pirota MV, Paller CJ. Phytotherapeutic interventions in the management of biochemically recurrent prostate cancer: a systematic review of randomised trials. *BJU international.* 2016;1174(4):17-34.
 45. Poustforoosh A, Faramarz S, Negahdaripour M, Tüzün B, Hashemipour H. Investigation on the mechanisms by which the herbal remedies induce anti-prostate cancer activity: uncovering the most practical natural compound. *Journal of biomolecular structure & dynamics.* 2023, 1-14.
 46. G WW, L MB, D EW, R HD, Ho E. Phytochemicals from cruciferous vegetables, epigenetics, and prostate cancer prevention. *Aaps j.* 2013;15(4):951-961.
 47. Azizi A, Mumin NH, Shafqat N. Phytochemicals with Anti 5-alpha-reductase Activity: A Prospective for Prostate Cancer Treatment. *F1000Research.* 2021;10:221.
 48. Jameel M, Fatma H, Nadochii LA, Siddique HR. Molecular Insight into Prostate Cancer: Preventive Role of Selective Bioactive Molecules. *Life (Basel, Switzerland).* 2023, 13(10).
 49. Gano CA, Fatima S, Failes TW, *et al.* Anti-cancer potential of synergistic phytochemical combinations is influenced by the genetic profile of prostate cancer cell lines. *Frontiers in nutrition.* 2023;10:1119274.
 50. Xu X, Li J, Wang X, *et al.* Tomato consumption and prostate cancer risk: a systematic review and meta-analysis. *Sci Rep.* 2016;6:37091.
 51. Liu B, Mao Q, Cao M, Xie L. Cruciferous vegetables intake and risk of prostate cancer: a meta-analysis. *Int J Urol.* 2012;19(2):134-141.
 52. Zhou XF, Ding ZS, Liu NB. Allium vegetables and risk of prostate cancer: evidence from 132,192 subjects. *Asian Pac J Cancer Prev.* 2013;14(7):4131-4134.
 53. Hwang YW, Kim SY, Jee SH, Kim YN, Nam CM. Soy food consumption and risk of prostate cancer: a meta-analysis of observational studies. *Nutr Cancer.* 2009;61(5):598-606.
 54. Schwingshackl L, Schwedhelm C, Galbete C, Hoffmann G. Adherence to Mediterranean Diet and Risk of Cancer: An Updated Systematic Review and Meta-Analysis. *Nutrients.* 2017, 9(10).
 55. Yan H, Cui X, Zhang P, Li R. Fruit and Vegetable Consumption and the Risk of Prostate Cancer: A Systematic Review and Meta-Analysis. *Nutr Cancer.* 2022;74(4):1235-1242.
 56. Michels N, Specht IO, Heitmann BL, Chajès V, Huybrechts I. Dietary trans-fatty acid intake in relation to cancer risk: a systematic review and meta-analysis. *Nutr Rev.* 2021;79(7):758-776.
 57. Pan B, Lai H, Ma N, *et al.* Association of soft drinks and 100% fruit juice consumption with risk of cancer: a systematic review and dose-response meta-analysis of prospective cohort studies. *The international journal of behavioral nutrition and physical activity.* 2023;20(1):58.
 58. Leong JY, Pinkhasov R, Chandrasekar T, *et al.* Prostate-specific Antigen Testing in Men with Disabilities: A Cross-sectional Analysis of the Health Information National Trends Survey. *European urology focus.* 2022;8(5):1125-1132.
 59. Micai M, Ciaramella A, Salvitti T, *et al.* Autistic Adult Health and Professional Perceptions of It: Evidence From the ASDEU Project. *Front Psychiatry.* 2021;12:614102.
 60. Hugosson J, Månsson M, Wallström J, *et al.* Prostate

- Cancer Screening with PSA and MRI Followed by Targeted Biopsy Only. *N Engl J Med.* 2022;387(23):2126-2137.
61. Ilic D, Djulbegovic M, Jung JH, *et al.* Prostate cancer screening with prostate-specific antigen (PSA) test: a systematic review and meta-analysis. *Bmj.* 2018;362:k3519.
 62. Osborn DP, Horsfall L, Hassiotis A, Petersen I, Walters K, Nazareth I. Access to cancer screening in people with learning disabilities in the UK: cohort study in the health improvement network, a primary care research database. *PLoS One.* 2012;7(8):e43841.
 63. Zerbo O, Qian Y, Ray T, *et al.* Health Care Service Utilization and Cost Among Adults with Autism Spectrum Disorders in a U.S. Integrated Health Care System. *Autism in adulthood: challenges and management.* 2019;1(1):27-36.
 64. Weir E, Allison C, Baron-Cohen S. The sexual health, orientation, and activity of autistic adolescents and adults. *Autism research: official journal of the International Society for Autism Research.* 2021;14(11):2342-2354.
 65. Attanasio M, Masedu F, Quattrini F, *et al.* Are Autism Spectrum Disorder and Asexuality Connected? *Arch Sex Behav.* 2022;51(4):2091-2115.
 66. Maggio MG, Calatozzo P, Cerasa A, Pioggia G, Quartarone A, Calabro RS. Sex and Sexuality in Autism Spectrum Disorders: A Scoping Review on a Neglected but Fundamental Issue. *Brain sciences.* 2022, 12(11).
 67. Young S, Cocallis K. A Systematic Review of the Relationship between Neurodiversity and Psychosexual Functioning in Individuals with Autism Spectrum Disorder (ASD) or Attention-Deficit/Hyperactivity Disorder (ADHD). *Neuropsychiatr Dis Treat.* 2023;19:1379-1395.
 68. Mehzabin P, Stokes M. Self-assessed sexuality in young adults with High-Functioning Autism. *Research in autism spectrum disorders.* 2011;5:614-621.
 69. Jian Z, Ye D, Chen Y, Li H, Wang K. Sexual Activity and Risk of Prostate Cancer: A Dose-Response Meta-Analysis. *J Sex Med.* 2018;15(9):1300-1309.
 70. Rider JR, Wilson KM, Sinnott JA, Kelly RS, Mucci LA, Giovannucci EL. Ejaculation Frequency and Risk of Prostate Cancer: Updated Results with an Additional Decade of Follow-up. *Eur Urol.* 2016;70(6):974-982.
 71. Lozano-Lorca M, Olmedo-Requena R, Barrios-Rodríguez R, *et al.* Ejaculation Frequency and Prostate Cancer: CAPLIFE Study. *The world journal of men's health.* 2023;41(3):724-733.
 72. Turner D, Briken P, Schöttle D. Sexual Dysfunctions and Their Association with the Dual Control Model of Sexual Response in Men and Women with High-Functioning Autism. *Journal of clinical medicine.* 2019, 8(4).
 73. Kloner RA, Stanek E, Crowe CL, *et al.* Effect of phosphodiesterase type 5 inhibitors on major adverse cardiovascular events and overall mortality in a large nationwide cohort of men with erectile dysfunction and cardiovascular risk factors: A retrospective, observational study based on healthcare claims and national death index data. *J Sex Med.* 2023;20(1):38-48.
 74. Chavez ACK, Rajab M, Jo C. Incidence rate of prostate cancer in men treated for erectile dysfunction with phosphodiesterase type 5 inhibitors: retrospective analysis. *Asian J Androl.* 2013;15:246-248.
 75. Dennis LK, Dawson DV. Meta-analysis of measures of sexual activity and prostate cancer. *Epidemiology.* 2002;13(1):72-79.
 76. Hancock GIP, Stokes MA, Mesibov GB. Socio-sexual functioning in autism spectrum disorder: A systematic review and meta-analyses of existing literature. *Autism research: official journal of the International Society for Autism Research.* 2017;10(11):1823-1833.
 77. Crehan ET, Rocha J, Sclar J, Ward O, Donaghue A. Topics and timing of sexuality and relationship education for autistic and non-autistic adults in the United States. *Disability and health journal.* 2023;16(3):101466.
 78. Dewinter J, Onaiwu MG, Massolo ML, *et al.* Short report: Recommendations for education, clinical practice, research, and policy on promoting well-being in autistic youth and adults through a positive focus on sexuality and gender diversity. *Autism: The international journal of research and practice.* 2023, 13623613231188349.
 79. Maggio MG, Calatozzo P, Cerasa A, Pioggia G, Quartarone A, Calabrò RS. Sex and Sexuality in Autism Spectrum Disorders: A Scoping Review on a Neglected but Fundamental Issue. *Brain sciences,* 2022, 12(11).
 80. Chianese AA, Jackson SZ, Souders MC. Psychosexual knowledge and education in autism spectrum disorder individuals. *Journal of the American Association of Nurse Practitioners.* 2020;33(10):776-784.
 81. Girardi A, Curran MS, Snyder BL. Healthy Intimate Relationships and the Adult with Autism. *J Am Psychiatr Nurses Assoc.* 2021;27(5):405-414.
 82. Platos M, Wojaczek K, Laugeson EA. Fostering Friendship and Dating Skills among Adults on the Autism Spectrum: A Randomized Controlled Trial of the Polish Version of the PEERS® for Young Adults Curriculum. *J Autism Dev Disord.* 2023, 1-16.
 83. Coughlin SS. A review of social determinants of prostate cancer risk, stage, and survival. *Prostate international.* 2020;8(2):49-54.
 84. Guo Z, Gu C, Li S, *et al.* Association between Marital Status and Prognosis in Patients with Prostate Cancer: A Meta-Analysis of Observational Studies. *Urology journal.* 2020;18(4):371-379.
 85. Yu P, Xu R, Li S, *et al.* Exposure to wildfire-related PM2.5 and site-specific cancer mortality in Brazil from 2010 to 2016: A retrospective study. *PLoS medicine.* 2022;19(9):e1004103.
 86. Kenfield SA, Stampfer MJ, Chan JM, Giovannucci E. Smoking and prostate cancer survival and recurrence. *JAMA.* 2011;305(24):2548-2555.
 87. Silva JF, Mattos IE, Luz LL, Carmo CN, Aydos RD. Exposure to pesticides and prostate cancer: systematic review of the literature. *Reviews on environmental health.* 2016;31(3):311-327.
 88. Krstev S, Knutsson A. Occupational Risk Factors for Prostate Cancer: A Meta-analysis. *J Cancer Prev.* 2019;24(2):91-111.
 89. Blanc-Lapierre A, Sauvé JF, Parent ME. Occupational exposure to benzene, toluene, xylene and styrene and risk of prostate cancer in a population-based study.

- Occup Environ Med. 2018;75(8):562-572.
90. Goldberg MS, Zapata-Marin S, Labrèche F, *et al.* Ambient exposures to selected volatile organic compounds and the risk of prostate cancer in Montreal. *Environmental epidemiology (Philadelphia, Pa)*. 2022;6(6):e231.
 91. Vella V, Malaguarnera R, Lappano R, Maggiolini M, Belfiore A. Recent views of heavy metals as possible risk factors and potential preventive and therapeutic agents in prostate cancer. *Mol Cell Endocrinol*. 2017;457:57-72.
 92. Youogo LMK, Parent ME, Hystad P, Villeneuve PJ. Ambient air pollution and prostate cancer risk in a population-based Canadian case-control study. *Environmental epidemiology (Philadelphia, Pa)*. 2022;6(4):e219.
 93. Ranjan S, Nasser JA. Nutritional status of individuals with autism spectrum disorders: do we know enough? *Advances in nutrition (Bethesda, Md)*. 2015;6(4):397-407.
 94. Michael C. Why we need research about autism and ageing. *Autism: the international journal of research and practice*. 2016;20(5):515-516.
 95. Li H, Liu H, Chen X, Zhang J, Tong G, Sun Y, *et al.* Association of food hypersensitivity in children with the risk of autism spectrum disorder: a meta-analysis. *European journal of pediatrics*. 2021;180(4):999-1008.
 96. Hodder RK, Stacey FG, Wyse RJ, *et al.* Interventions for increasing fruit and vegetable consumption in children aged five years and under. *The Cochrane database of systematic reviews*. 2017;9(9):Cd008552.
 97. Savoie-Roskos MR, Wengreen H, Durward C. Increasing Fruit and Vegetable Intake among Children and Youth through Gardening-Based Interventions: A Systematic Review. *Journal of the Academy of Nutrition and Dietetics*. 2017;117(2):240-250.
 98. Garrido MM, Bernardino RM, Marta JC, Holdenrieder S, Guimaraes JT. Tumour markers in prostate cancer: The post-prostate-specific antigen era. *Ann Clin. Biochem*. 2022;59(1):46-58.