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Nutrition perceptions, needs and practices among patients with plasma cell disorders

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INTRODUCTION

As patients with Plasma Cell Disorders (PCDs) live longer due to therapeutic advances, outcomes may be further improved by optimizing nutrition. Additionally, monoclonal gammopathy of undetermined significance (MGUS) and low- to intermediate-risk smoldering multiple myeloma (SMM) present unique opportunities for early intervention, given the standard of care is observation over time [1].

Epidemiologic studies have confirmed that diet is a known risk factor for PCDs [2]. Two large prospective cohort studies support that Western diets, noted for their high inflammatory or insulinemic potential, may be linked to an increased risk of multiple myeloma (MM), while vegetarians and vegans have decreased risk compared to meat-eaters [3, 4]. Further studies based on individual dietary components suggest that increased consumption of fruits, vegetables, whole grains, and seafood is associated with a reduced risk of PCDs [5–7] (https://pubmed.ncbi.nlm.nih.gov/9639389/). In addition, MM-specific mortality is lower in patients with healthful pre-diagnosis dietary patterns, suggesting the potential for diet to affect survival outcomes as well [8]. Although the exact mechanistic basis of diet in plasma cell dyscrasias is unknown, early studies suggest the microbiome may play a significant role (https://www.medrxiv.org/content/10.1101/2022.03.29.22272361v1).

Patients with PCDs are often interested in learning how to optimize their physical health through diet, but oncologists and hematologists commonly do not address these concerns possibly due to the lack of PCD-specific dietary guidelines, although general guidelines by the American Institute for Cancer Research (AICR) and the American Cancer Society (ACS) for cancer prevention and survivorship do exist [9, 10]. Therefore, they are applicable to MGUS and SMM in addition to MM. The aim of this 24-question online survey was to explore patients' nutrition information needs, perceptions, and practices and to identify areas for further research.

SUBJECTS AND METHODS

We utilized HealthTree® Cure Hub, an online tool created by HealthTree Foundation (a division of the 501(c)3 non-profit organization, CrowdCare Foundation), and invited participants with PCDs to answer questions pertaining to their diet and nutrition and related experience with their hematologists and oncologists [11]. This study was reviewed by the Memorial Sloan Kettering Cancer Center Institutional Review Board and determined to be exempt from further review (IRB X20-091). Over 8000 patients with a known history of PCDs in the United States had access to this survey from January to June 2021. Participants provided written informed consent at survey initiation. Deidentified survey responses and pre-collected health data for each participant were retrieved through the HealthTree platform at study conclusion. Summary statistics were used to estimate the distribution of responses across questions as a function of the number of participants that answered a given question. Differences in question responses between patients diagnosed with malignant (primary plasma cell leukemia (PCL), MM) versus precursor conditions (MGUS, SMM, plasmacytoma) were tested using Fisher's exact test. McNemar's Chi-square test was used to assess dietary shifts pre- and post-diagnosis.

RESULTS

We obtained 421 survey respondents: 205 (49%) ≤65 years, 153 (36%) male, and 282 (67%) white. A range of PCD diagnoses were represented, including 299 (71%) MM, 63 (15%) SMM, 18 (4%) MGUS, 6 (1%) solitary plasmacytoma, 1 (0%) PCL, and 34 (8%) unknown. There was no statistically significant difference in survey responses between those diagnosed with malignant versus precursor conditions. Overall, the majority of respondents (82%) reported having questions or concerns about diet and nutrition (i.e., foods to eat or avoid, portion sizes, and special diets) while fewer than half (43%) indicated that their hematologist or oncologist either appropriately addressed them directly (23%) or referred the patient to a dietician or nutritionist (20%). Moreover, 57% stated that diet and nutrition were not addressed by their hematologists or oncologists at all and 23% stated this topic was not addressed despite asking. Most patients (71%) reported that their hematologist or oncologist spent <10 min discussing nutrition with them; 41% spent 0 min (Table 1).

About a third of respondents (29%) reported receiving non-specific dietary advice from their hematologist or oncologist, such as to eat a "balanced diet" or to consume less to lose weight, while 15% reported receiving more detailed meaningful guidance (i.e., recommended specific plant-based foods, fiber-rich foods, plant proteins, and/or less junk/fatty foods). Survey results reveal that of the patients that were able to receive dietary recommendations from hematologists or oncologists, the vast majority (94%) stated that they attempted to follow the advice. Additionally, although the ACS and the AICR have published dietary guidelines, 34% of respondents were aware of these guidelines, and of this group 47% attempted to follow them (Table 1).

Lack of knowledge and conflicting advice were barriers to making dietary changes for 14 and 23% of respondents, respectively. Presently, most receive post-diagnosis dietary guidance from non-medical sources, online, television, books, magazines, and other media (46%), advice from non-medical friends or family (10%) and alternative practitioners (naturopath,

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Table 1. Perceptions and Experiences with Hematologists and Oncologists Regarding Diet and Nutrition.

Past Experience Discussing Diet and Nutrition with Hematologists and Oncologists	
1. Since your plasma cell diagnosis, have you had questions or concerns about diet and nutrition?	*n* = 417 (%)
Yes	341 (82)
2. Which statement best describes your experience discussing diet and nutrition with your oncologist/hematologist?	*n* = 417 (%)*
Hematologist/Oncologist addressed it appropriately	96 (23)
Hematologist/Oncologist did not address it	238 (57)
Hematologist/Oncologist did not address it despite the patient asking	97 (23)
Hematologist/Oncologist referred patient to a dietician/nutritionist	83 (20)
3. Time spent discussing diet/nutrition with hematologist/oncologist:	*n* = 364 (%)
0 minutes	149 (41)
< 10 minutes	257 (71)
≥ 10 minutes	107 (29)
4. What advice did you receive from your hematologist/oncologist?	*n* = 379 (%)*
Eat more plant-based foods, fiber-rich foods, plant proteins, and/or less junk/fatty foods	55 (15)
Eat a balanced diet (without details given) or lose weight by eating less	110 (29)
Referred to nutritionist/dietician	94 (25)
None – received no advice about diet and nutrition	168 (44)
5. If your oncologist/hematologist gave you dietary recommendations, were you able to follow them?	*n* = 123 (%)
Yes, I tried to follow them or successfully followed them	116 (94)
Knowledge of Implementing Dietary Changes Post Plasma Cell Disorder Diagnosis	
6. Are you aware of the dietary guidelines for cancer from the American Institute for Cancer Research or the American Cancer Society?	*n* = 387 (%)
Yes	130 (34)
7. Did you change your diet based on the guidelines from the American Institute for Cancer Research or the American Cancer Society?	*n* = 127 (%)
Yes, I follow them or attempted to follow them	60 (47)
I have heard of them but made unrelated dietary changes	27 (21)
8. If you made dietary changes post-diagnosis, which resources did you use to make these changes?	*n* = 384 (%)*
Advice from primary care physician and/or hematologist/oncologist	32 (8)
Advice from a dietician or nutritionist	91 (24)
Advice from non-medical friends or family	38 (10)
Alternative practitioner – Naturopath, Ayurveda, Chiropractor etc.	31 (8)
Online and/or television, books, magazines, and other media	178 (46)
Other	41 (11)
Not relevant – I did not make any changes	100 (26)
9. What are the barriers you see to changing your diet?	*n* = 388 (%)*
Conflicting advice making it unclear what to follow	85 (22)
Lack of knowledge	54 (14)
Family and social pressure	48 (12)
Own habits and preferences	215 (55)
Not enough time to prepare	40 (10)
Too costly	19 (5)
Other	40 (10)
None	107 (28)
Future Interest in Learning About Diet, Nutrition, and Plasma Cell Disorder Diagnosis	
10. Are you interested in learning more about the research on nutrition and your PCD diagnosis?	*n* = 386 (%)
Yes	348 (90)
11. Would you like your oncologist/hematologist to make recommendations on diet and your diagnosis?	*n* = 389 (%)
Yes	255 (66)
12. Are you interested in changing your diet based on dietary research information available for your diagnosis?	*n* = 388 (%)
Yes	318 (82)

*Participants had the option to select multiple answers (all that applied to them).

Ayurvedic doctor, chiropractor, etc.) (8%). Hematologists, oncologists, or primary care providers were a resource in making post-diagnosis dietary changes for 8%, and 24% received advice from dieticians or nutritionists (Table 1).

Most respondents (90%) indicated that they were interested in learning more about nutrition research and their diagnosis, 82% confirmed their interest in changing their diet based on this research, and 66% expressed that they would like their oncologist to make recommendations (Table 1). The most common motivating reasons reported by patients for implementing dietary changes include feeling better physically (68%), taking more control of one's health (62%), feeling better emotionally (47%), looking better (42%), and losing weight (37%).

A significant number of patients self-reported that they consumed a healthier diet after diagnosis (75% pre versus 88% post, $p < 0.0001$). Furthermore, among patients with a self-reported unhealthy diet pre-diagnosis, 73% improved their diet post-diagnosis. In contrast, 6% with a healthy diet pre-diagnosis

Table 2. Self-reported dietary patterns in patients pre-PCD diagnosis versus post-PCD diagnosis.

	Pre- PCD Diagnosis		Post- PCD Diagnosis		*p*-value*
	N	(%)	*N*	(%)	
Self-Reported General Dietary Patterns, *N* = 268					
Healthy	201	(75)	237	(88)	**8.80e-06**
Unhealthy	67	(25)	31	(12)	
Self-Reported Consumption of Specific Food Groups					
Whole Fruit, *N* = 366					
≥ 1-2 times weekly	335	(92)	358	(98)	**4.5e-06**
≥ 3-6 times weekly	259	(71)	316	(86)	**1.8e-10**
≥ 1-2 times daily	150	(41)	199	(54)	**1.2e-08**
≥ 3 times daily	37	(10)	63	(17)	**3.1e-05**
Vegetables, *N* = 362					
≥ 1-2 times weekly	351	(97)	359	(99)	**0.01**
≥ 3-6 times weekly	294	(81)	325	(90)	**2.7e-05**
≥ 1-2 times daily	180	(50)	226	(62)	**3.5e-07**
≥ 3 times daily	37	(10)	63	(17)	**2.9e-05**
Whole Grains, *N* = 360					
≥ 1-2 times weekly	302	(84)	324	(90)	**0.0002**
≥ 3-6 times weekly	210	(58)	248	(69)	**9.8e-06**
≥ 1-2 times daily	114	(32)	131	(36)	**0.01**
≥ 3 times daily	17	(5)	19	(5)	0.7728
Plant Proteins, *N* = 340					
≥ 1-2 times weekly	252	(74)	301	(89)	**2.0e-10**
≥ 3-6 times weekly	141	(41)	216	(64)	**1.0e-15**
≥ 1-2 times daily	37	(11)	83	(24)	**9.1e-10**
≥ 3 times daily	4	(1)	10	(3)	0.0771
Plant-Based Dairy, *N* = 338					
≥ 1-2 times weekly	161	(48)	216	(64)	**4.2e-11**
≥ 3-6 times weekly	107	(32)	164	(49)	**4.9e-10**
≥ 1-2 times daily	44	(13)	82	(24)	**1.3e-07**
≥ 3 times daily	3	(1)	6	(2)	0.2482
Dairy Products, *N* = 347					
≥ 1-2 times weekly	318	(92)	305	(88)	**0.05**
≥ 3-6 times weekly	265	(76)	238	(69)	**0.003**
≥ 1-2 times daily	144	(41)	130	(37)	0.08
≥ 3 times daily	18	(5)	15	(4)	0.5465
Seafood, *N* = 350					
≥ 1-2 times weekly	188	(54)	238	(68)	**1.2e-08**
≥ 3-6 times weekly	28	(8)	65	(19)	**4.6e-07**
≥ 1-2 times daily	3	(1)	2	(1)	1
≥ 3 times daily	0	(0)	0	(0)	**na**
Eggs, *N* = 359					
≥ 1-2 times weekly	251	(70)	255	(71)	0.70
≥ 3-6 times weekly	114	(32)	122	(34)	0.40
≥ 1-2 times daily	25	(7)	23	(6)	0.82
≥ 3 times daily	1	(0)	1	(0)	1
Poultry, *N* = 345					
≥ 1-2 times weekly	291	(84)	280	(81)	0.10
≥ 3-6 times weekly	145	(42)	139	(40)	0.53
≥ 1-2 times daily	6	(2)	8	(2)	0.62
≥ 3 times daily	0	(0)	0	(0)	na
Red Meats, *N* = 333					
≥ 1-2 times weekly	194	(58)	116	(35)	**4.8e-16**
≥ 3-6 times weekly	88	(26)	39	(12)	**8.0.e-10**
≥ 1-2 times daily	10	(3)	5	(2)	0.18
≥ 3 times daily	1	(0)	1	(0)	**na**
Sweetened Drinks, *N* = 336					
≥ 1-2 times weekly	146	(43)	101	(30)	**2.5e-07**
≥ 3-6 times weekly	94	(28)	54	(16)	**< 2.2e-16**
≥ 1-2 times daily	45	(13)	25	(7)	**< 2.2e-16**
≥ 3 times daily	16	(5)	7	(2)	**0.02**
Junk Foods, *N* = 341					
≥ 1-2 times weekly	273	(80)	215	(63)	**2.28e-12**
≥ 3-6 times weekly	174	(51)	108	(32)	**3.67e-13**
≥ 1-2 times daily	46	(13)	26	(8)	**5.104e-05**
≥ 3 times daily	9	(3)	2	(1)	**0.02334**

*McNemar's Chi-square test with continuity correction.
Trending towards general increase in consumption.
Trending towards general decrease in consumption.

worsened their diet post-diagnosis (Table 2). Patients reported consuming food groups such as whole fruits, vegetables, whole grains, plant proteins, plant-based dairy, and seafood at significantly higher rates post-diagnosis ($p < 0.0001$). There was a concurrent decrease in the consumption of red meats, dairy products, sweetened drinks, and junk foods (Table 2).

DISCUSSION

Survey responses indicated that patients often change their diets post-diagnosis, suggesting that they may be amenable to dietary interventions. Cancer patients have been well-documented to make dietary changes following a diagnosis, and this trend extends to PCD patients [12] (https://pubmed.ncbi.nlm.nih.gov/12616253/). A cancer diagnosis can induce psychological stress which can motivate individuals to reduce known risk factors and promote general health [13]. Our results confirm that besides patients with active plasma cell malignancies, patients with precursor conditions such as MGUS may be similarly empowered to make dietary and lifestyle changes as they are apprehensive about their cancer progression risk. The lack of difference in survey responses between patients with active cancer and precursor disorders maybe due to the small sample size. The role of diet is possibly different across the plasma cell disorder spectrum and may be dependent on disease stage, nutritional status, comorbidities, and patient preference.

Additionally, a meta-analysis evaluating the effectiveness of primary care-based dietary interventions showed that personalized guidance from healthcare professionals can usher sustainable healthy diets in patients (https://doi.org/10.1002/1099-1611(200009/10)9:5%3C418::AID-PON474%3E3.0.CO;2-E). This suggests that patients who get professional guidance make healthier shifts. Of the 123 patients that reported receiving dietary advice directly from hematologists and oncologists, an overwhelming 94% stated that they attempted to follow the advice. This highlights the positive influence physicians may have in propelling healthful dietary changes.

Our results also highlight the important role that dieticians and non-medical sources (internet, books, magazines, social media) play, given that despite 90% of respondents desired dietary information, only 66% expressed interest in receiving guidance from their oncologist or hematologist. This study indicates that though patients with PCDs are inclined to eat more healthfully post-diagnosis, the majority currently do not receive this information from physicians and may benefit from professional input from dietitians or physicians to alleviate any uncertainties regarding diet and nutrition.

Strengths of this study include the large sample size. A limitation includes the flexible branching logic of the survey instrument which allowed patients to selectively answer certain questions. Thus, we captured differing response rates across some sections (i.e., Table 1 versus Table 2 questions) as participants were less likely to complete questions further along the survey. Alternatively, this scheme allowed for a larger clinical sample size. The retrospective nature of surveys may have led to recall bias in patients, producing an overestimation of effect size when comparing pre-diagnosis habits with those post-diagnosis. Although the selection of HealthTree Cure Hub as the platform to disseminate the survey lent itself to greater outreach amongst patients, this may have led to a self-selection bias from patients who are interested in this topic and may already have made dietary changes. Beyond selection bias, the generalizability of these results may be constrained by the low response rate (5.3%) given 421 responses were captured despite 8000 site visitors. However, the exact number of patients active on the site during the survey period is unknown and is likely under 8000.

CONCLUSIONS

To summarize, our survey reveals a missed opportunity between patients' need for dietary advice and the potential for hematologists and oncologists to provide helpful counsel. Patients with PCDs are interested in dietary advice from hematologists and oncologists to make healthful dietary switches. Most patients currently make dietary changes post-diagnosis. However, they receive advice pertaining to diet and nutrition from non-medical sources and report barriers related to lack of consistent information. Our findings highlight a need for additional research into standardized guideline (AICR and ACS) implementation as well as for the development of PCD-specific guidelines by hematologists and oncologists. Further disease focused dietary studies among patients with PCDs, especially those aiming to assess the impact of defined dietary interventions on biomarkers of disease prognosis and survival outcomes (e.g., NCT04920084), are essential to fill this gap.

Maria A. Malik[1,2], Nathan W. Sweeney[3], Mohammad Jafri[4], Andriy Derkach[5], Cynthia Chmielewski[3], Peter A. Adintori[6], Sham Mailankody[2], Neha Korde[2], Carlyn R. Tan[2], Hani Hassoun[2], Malin Hultcrantz[2], Jens Hillengass[7], Susan E. McCann[8], Neil Iyengar[9], Saad Usmani[2], Sergio A. Giralt[6,10], Ola Landgren[2,11], Marcel R. M. van den Brink[6], Jennifer M. Ahlstrom[3], Alexander M. Lesokhin[2], Anita D'Souza[12] ✉ Susan Chimonas[13] and Urvi A. Shah[2] ✉

[1]Geisel School of Medicine at Dartmouth, Hanover, NH, USA. [2]Myeloma Service, Department of Medicine, Memorial Sloan Kettering Cancer Center, New York, NY, USA. [3]HealthTree Foundation, Lehi, UT, USA. [4]Memorial Sloan Kettering Cancer Center, New York, NY, USA. [5]Department of Biostatistics and Epidemiology, Memorial Sloan Kettering Cancer Center, New York, NY, USA. [6]Department of Medicine, Adult Bone Marrow Transplant Service, Memorial Sloan Kettering Cancer Center, New York, NY, USA. [7]Department of Medicine, Roswell Park Comprehensive Cancer Center, Buffalo, NY, USA. [8]Department of Cancer Prevention and Control, Roswell Park Comprehensive Cancer Center, Buffalo, NY, USA. [9]Department of Medicine, Breast Service, Memorial Sloan Kettering Cancer Center, New York, NY, USA. [10]Cellular Therapeutics Center, Memorial Sloan Kettering Cancer Center, New York, NY, USA. [11]Myeloma Program, Department of Medicine, University of Miami, Sylvester Comprehensive Cancer Center, Miami, FL, USA. [12]Division of Hematology/Oncology, Department of Medicine, Medical College of Wisconsin, Milwaukee, WI, USA. [13]Center for Health Policy and Outcomes, Memorial Sloan Kettering Cancer Center, New York, NY, USA. ✉email: shahu@mskcc.org

DATA AVAILABILITY

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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AUTHOR CONTRIBUTIONS

UAS, MJ, SC, NS, JA, CC, AML, JMA, NI conceived and designed the study. UAS, MM, AD, NWS, curated, analyzed, accessed, verified, and interpretated data. UAS, MM, AD, NWS, JH, SM, SC, ADS, AML, SZU, SAG, MVDB, NI, SEM, SM, NK, CRT, HH, MH, PAA drafted and edited the manuscript. UAS, MM, AD, NWS, had full access to the data and share final responsibility for submission of the publication. All authors wrote and approved the article and are accountable for publication.

COMPETING INTERESTS

UAS has received grants and research support from Celgene/Bristol Myers Squibb, Janssen paid to the institution, personal fees from Janssen, MJH Life Sciences, ACCC, MashUpMD all outside of the submitted work. SG reports personal fees and advisory role (scientific advisory board) from Actinnum, Celgene, Bristol Myers Squibb, Sanofi, Amgen, Pfizer, GlaxoSmithKline, JAZZ, Janssen, Omeros, Takeda, and Kite, outside the submitted work. HH reports grants from Celgene, during the conduct of the study; and grants from Celgene, Takeda, and Janssen, outside the submitted work. NK reports research funding through Amgen and participates in advisory board with Medimmune. OLan reports grants from Amgen, Janssen, and Takeda; Data Monitoring Committee from Janssen, Merck, and Takeda; and personal fees from Amgen, Janssen, GlaxoSmithKline, AstraZeneca, and The Binding Site, outside the submitted work. AML reports grants from Novartis, during the conduct of the study; grants from Bristol Myers Squibb; personal fees from Trillium Therapeutics; grants, personal fees and nonfinancial support from Pfizer; and grants and personal fees from Janssen, outside the submitted work. AML also has a patent US20150037346A1 with royalties paid. SM reports research funding from Allogene Therapeutics, Juno/Bristol Myers Squibb, Takeda Oncology, and Janssen Oncology; personal fees from Plexus communication, and Physician Education Resource, outside the submitted work. CT reports other from Janssen Research and Development outside the submitted work. JH has received personal fees and scientific advisory board fees from Amgen, Janssen Biotech, Glaxo Smith Kline, Bristol Myers Scribbs, Skyline, Oncopeptides and Sanofi.SZU reports grant support from Amgen, Array Biopharma, BMS, Celgene, GSK, Janssen, Merck, Pharmacyclics, Sanofi, Seattle Genetics, SkylineDX and Takeda; personal fees from Amgen, BMS, Celgene, EdoPharma, Genentech, Gilead, GSK, Janssen, Oncopeptides, Sanofi, Seattle Genetics, SecuraBio, SkylineDX, Takeda and TeneoBio; outside the submitted work.MVDB has received research support and stock options from Seres Therapeutics and stock options from Notch Therapeutics and Pluto Therapeutics; he has received royalties from Wolters Kluwer; has consulted, received honorarium from or participated in advisory boards for Seres Therapeutics, WindMIL Therapeutics, Rheos Medicines, Merck & Co, Inc., Magenta Therapeutics, Frazier Healthcare Partners, Nektar Therapeutics, Notch Therapeutics, Forty Seven Inc., Ceramedix, Lygenesis, Pluto Therapeutics, GlaskoSmithKline, Da Volterra, Novartis (Spouse), Synthekine (Spouse), and Beigene (Spouse); he has IP Licensing with Seres Therapeutics and Juno Therapeutics; and holds a fiduciary role on the Foundation Board of DKMS (a nonprofit organization).

ADDITIONAL INFORMATION

Correspondence and requests for materials should be addressed to Urvi A. Shah.