



Humanistic burden of living with anaplastic lymphoma kinase-positive non-small-cell lung cancer: findings from the ALKConnect patient insight network and research platform

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Aim: Evaluate real-world patient preferences, experiences and outcomes (health-related quality of life [HRQoL]) from patients with anaplastic lymphoma kinase-positive (ALK+) non-small-cell lung cancer (NSCLC) utilizing the ALKConnect Patient Insight Network. **Patients & methods:** Demographics, disease history/status/treatment, patient preferences and HRQoL (MD Anderson Symptom Inventory lung cancer module, reported as symptom severity and interference) were evaluated for US adults with ALK+ NSCLC. **Results:** Among 104 patients (median age: 53.0 years, 67.3% female, 40.0% employed), HRQoL and 3-month delay in disease progression were important treatment attributes. Burdensome symptoms included fatigue and disturbed sleep. Symptoms interfered most with work and day-to-day activity. Higher HRQoL was associated with ALK tyrosine kinase inhibitor (TKI) treatment and employment. **Conclusion:** ALKConnect demonstrated that disease progression, HRQoL, fatigue/sleep, ALK TKIs and employment matter in ALK+ NSCLC.

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Keywords: anaplastic lymphoma kinase-positive (ALK+) • health-related quality of life (HRQoL) • non-small-cell lung cancer (NSCLC) • symptom interference • symptom severity • tyrosine kinase inhibitors (TKIs)

Approximately 1 million people are diagnosed with lung cancer, and 1.8 million lung cancer deaths occur worldwide each year [1]. Most people with lung cancer have non-small cell lung cancer (NSCLC; 85–90%), and these people typically present with advanced disease upon initial diagnosis [2–4]. Anaplastic lymphoma kinase-positive (ALK+) NSCLC is a subset of NSCLC that is present in approximately 3–5% of people with NSCLC [5–7]. ‘ALK-positive’ tumors (tumors harboring a rearranged *ALK* gene) are highly sensitive to therapy with ALK-targeted inhibitors [7,8]. Presence of an *ALK* rearrangement is usually associated with younger age, never or light smoking history, and adenocarcinoma histology [6,9–11]. Up to 50–60% of people with ALK+ NSCLC will develop brain metastases over the course of their disease [8,12,13]; this is an adverse prognostic factor [10] and contributor to a reduced quality of life (QoL) due to treatment requirements and symptom burden [14], as well as a feared complication for patients with ALK + NSCLC.

There has been a sweeping shift toward increased patient engagement and shared decision making in healthcare, defined broadly by the World Health Organization (WHO) as ‘the active involvement of patients in their own care, in order to enhance safety, quality and patient-centeredness of healthcare service delivery’ [15]. Engagement and

shared decision making includes giving patients greater ownership of their healthcare decisions through recognition of the patient perspective at all levels, to include patient preference, treatment options and discussions about individual care and goals through peer support, advocacy and organizational or national policy [16–18]. Evidence has shown that patients affected by cancer often have unmet emotional and social support needs [19] and that patients with lung cancer benefit from engagement in their healthcare [20,21].

Social media communities are vital sources of social and emotional connections for cancer survivors, providing support and mentorship to one another and sharing of similar experiences and relevant information that includes guidance and direction about disease education, medical experts, clinical trials, treatment options, side effect awareness and management, psych-social support and hope [22]. People affected by rare cancers may struggle to find shared experiences with other similar people and may need to look online for support and advice [22]. From a clinician or researcher perspective, online patient networks provide an innovative solution for gaining valuable insights into real-world experiences and outcomes that are meaningful to people, directly from people [23,24], offering first-hand insights into patients' experiences of care and into their unmet needs.

The ALKConnect Patient Insight Network and Research Platform offers an innovative way to conduct patient-centered research through web-based collection of real-world evidence directly from patients. Data collected through this platform may help us gain insights on their perspectives, real-world treatments, health-related quality of life (HRQoL) and experiences of care. Patients may contribute de-identified health data and information and can learn about other patients' diagnoses, treatments and experience of care from a web-based platform and with an assurance of privacy. Healthcare professionals and researchers can gain first-hand insights into patients' experiences of care and unmet needs to support discussions and direction of treatment plans for patients. In this study, the ALK Connect Platform was used to collect patient-reported insights regarding unmet needs, QoL, patient preferences and the treatment journey, via online patient survey.

While QoL was studied in clinical trials, little is known about the unique journeys, expectations and perspectives on the burden of disease of patients with ALK + NSCLC and what patients expect from new treatment options. Therefore, the objectives of this study were to analyze data collected from the ALKConnect Patient Insight Network and Research Platform in order to evaluate real-world patient-reported preferences, experiences and outcomes (e.g., health-related quality of life [HRQoL]) and to gain perspectives regarding treatments to identify unmet needs for patients with ALK+ NSCLC.

Patients & methods

The ALKConnect Patient Insight Network (www.alkconnect.com) is a patient-focused registry and prospective patient research platform from which cross-sectional real world data were collected from patients living with ALK+ NSCLC.

Study population

People meeting the following study criteria were enrolled in an online survey over a 2-year period between February 2017 and January 2019: adult people with ALK+ NSCLC, English-speaking and living in the United States and were willing to answer e-surveys. The study was central institutional review board (IRB)-approved and informed consent from patients was required to join.

Data collection

Demographic characteristics

Baseline demographic characteristics that were collected for people included age, ethnicity, race, sex, geographic region and employment status. Ethnicity and race data were collected because prior epidemiological data have suggested that there may be differences in ALK+ NSCLC prevalence by ethnicity and/or race [25].

Disease history, status & treatments

The survey included questions about patients' disease history and status and their treatment experience of living with ALK+ NSCLC. People were asked about the month and year of diagnosis with NSCLC and with ALK+ NSCLC and the disease stage at first diagnosis of each (Local, Metastatic, Regional, Unknown or Unsure). Additionally, people were asked to provide information about their current and previous treatments (Surgery, Radiation Therapy, Chemotherapy, ALK inhibitor [alectinib, ceritinib or crizotinib, as these were FDA approved at the time of survey initiation], Immunotherapy, Clinical Trial, No treatment, Unsure or Other), month and year of treatment initiation

and both treatment end date and reason for stopping treatment, for previous treatments only. Patients could specify other TKIs by selecting either the 'Clinical Trial' or 'Other' category (brigatinib and lorlatinib were FDA approved during the survey period; brigatinib in April 2017, and lorlatinib in November 2018).

Patient preferences for treatment

To elucidate information regarding preferences for treatment, patients were presented with a series of six statements regarding their current treatment and were asked to assign a rating to each statement regarding its importance to their choice of treatment in advanced lung cancer. The six statements were: treatment helps me live without my disease getting worse; treatment leads to shrinking my tumor size or keeping my disease stable within 3 months of taking it; treatment makes my lung cancer symptoms (e.g., cough, shortness of breath, chest pain) better; treatment does not have too many side effects (e.g., nausea/vomiting/diarrhea/constipation/rash); treatment maintains or improves my overall quality-of-life (physical, emotional and social aspects of life, stress level etc.); and treatment is easy to take (few pills per day, no food restrictions). Patients were considered to have ranked the treatment attribute 'Very Important' if they gave it a rating of 4 or 5 (scale 1–5; where 1 = no influence to 5 = most influence).

Patients were also asked to state their level of agreement (scale 1–5, where 1 = strongly disagree and 5 = strongly agree) with three statements regarding a new treatment: assuming similar side effects, if a new treatment gives me an additional 1 month delay in my cancer progressing, I would consider this improvement 'meaningful'; assuming similar side effects, if a new treatment gives me an additional 3 months of delay in my cancer progressing, I would consider this improvement 'meaningful'; and assuming similar side effects, if a new treatment gives me an additional 5 months of delay in my cancer progressing, I would consider this improvement 'meaningful.'

Health-related quality of life

The MD Anderson Symptom Inventory lung cancer module (MDASI-LC) is a MDASI module [26]. HRQoL subscales of the MDASI-LC include 13 symptom items (pain, fatigue, nausea, disturbed sleep, distress, shortness of breath, difficulty remembering, lack of appetite, drowsiness, dry mouth, sadness, vomiting, numbness/tingling) as well as six items assessing interference caused by symptoms (activity interference [walking, activity, work] and affective interference [relations with others, enjoyment, mood]) [26]. Patients were asked to rate how severe the symptoms have been in the last 24 h (scale 0–10 where 0 = symptom has not been present to 10 = the symptom was as bad as the patient could imagine it could be). A higher score on the MDASI scale corresponds with greater symptom severity, greater inference and a lower HRQoL.

Mean MDASI scores and the proportion of patients rating the symptom as moderate to severe were evaluated for each symptom. Patients were considered to have experienced moderate to severe symptom severity if they assigned the symptom a score of ≥ 5 on the MDASI. This threshold was based on prior work by Mendoza and colleagues [26,27], who demonstrated that a symptom severity score of 5 or higher for fatigue and pain on the MDASI-LC corresponded to moderate to severe symptoms that significantly impaired daily functioning. The MDASI threshold of scores ≥ 5 , reflecting moderate to severe symptoms was also adopted by Wang and Fu (2014) [27], who categorized scores as severe (scores ≥ 7), moderate (scores of 5–6), or mild (scores < 5).

Healthcare resource utilization

Healthcare resource use data that were collected included whether patients had hospital emergency room (ER) visits, overnight hospital stays and other visits with healthcare professionals and, the numbers of such visits, over the previous 6 months.

Invitae Corporation hosts and maintains the ALKConnect Patient Insight Network, providing operational, technical and program management. Only trained registry coordinators and curators have access to patient data to assist participants with their accounts and to provide de-identified data reports to Takeda Pharmaceutical Company Limited.

Statistical analysis

The data collected were reported descriptively for the population overall and by subgroups of interest (e.g., treatments, employment status), where sample sizes permitted. Summary measures such as means, standard deviations, medians and ranges (minimum and maximum) were used for continuous variables and counts and percentages were used for categorical variables. The associations between treatment history and patient-reported outcomes including health-related quality of life (HRQoL; e.g., responses to the MDASI-LC), healthcare resource use and

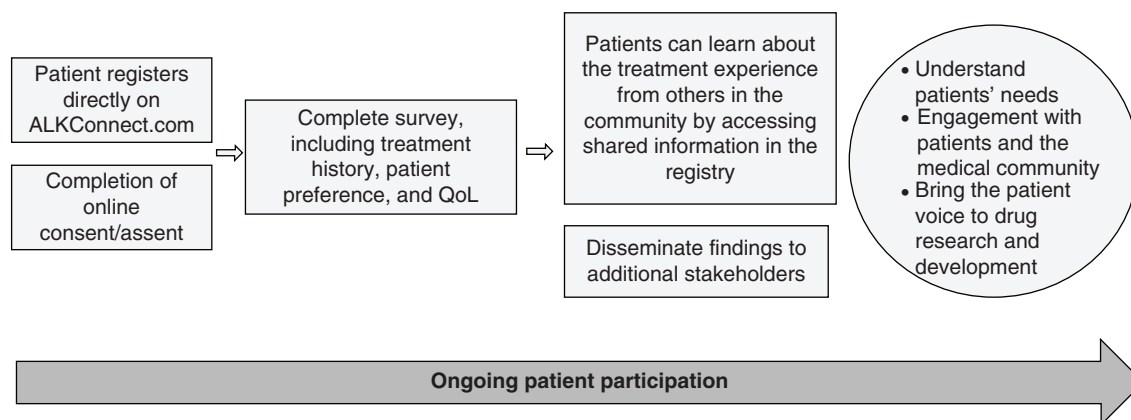


Figure 1. ALKConnect Patient Insight Network data collection, data dissemination, and patient participation (data collection from February 2017 to January 2019). QoL: Quality of life.

work productivity, were analyzed. Chi-square tests (for categorical variables) or ANOVAs (for continuous variables) were used to evaluate the associations. Statistical testing did not control for confounding variables due to the small sample size.

Results

Figure 1 presents the process of data collection, data dissemination and patient participation for the ALKConnect Patient Insight Network.

Demographic characteristics

A total of 104 patients completed the survey between February 2017 and January 2019. Mean (SD) age was 53.64 (12.44) years, and most patients were between the ages of 41–50 years (29.8%; n = 31) and 51–60 years (30.8%; n = 32). Approximately two-thirds of patients (67.3%; n = 70) were female, and forty percent of patients (n = 40) were employed, where ‘Employed’ included patients who indicated that they were self-employed, working full-time, working part-time and working from home. ‘Not Employed’ included patients who were on disability, full-time students, not working, retired, unemployed and homemakers (Table 1).

Disease history, status & treatments

Disease stage at first diagnosis of NSCLC and at diagnosis of ALK+ NSCLC were captured. At first diagnosis of ALK+ NSCLC, approximately three quarters of patients reported having metastatic disease (74.0%; n = 77), whereas 10.7% (n = 11) had regional disease, 6.7% (n = 7) had local disease, and the remainder did not know (5.8%; n = 6) or were unsure (2.9%; n = 3; Table 1). The median time elapsed between diagnosis with ALK+ NSCLC and survey completion was 25.6 months.

At the time of survey completion, most patients were being treated with ALK TKIs (85.6% [n = 89] (ALK TKI only; 83.7% [n = 87] and 1.9% [n = 2] ALK TKI and chemotherapy) while fewer patients were being treated with chemotherapy only (1.9%; n = 2), or other treatments (12.5% [n = 13]; i.e., not on ALK TKI or chemotherapy, including [not mutually-exclusive] radiation [n = 10], surgery [n = 7], clinical trial medication [n = 7], no treatment [n = 4], unsure [n = 3], other treatment [n = 3] or immunotherapy [n = 1]; Table 1). The median duration of treatment from start of current treatment up until the time of survey completion was longer for patients with ALK TKIs as their current treatment (13.8 months) than for patients with chemotherapy as their current treatment (7.7 months). Treatment lines included all types of therapy and were not limited to ALK TKIs. For almost half of the patients (47.3%), their current treatment was their second ALK+ NSCLC therapy. For three in ten patients (31.2%), this was their first-line therapy, for one in ten patients (11.8%) this was their third-line therapy, and the remaining one in ten patients (9.7%) had more than three lines of therapy. Supplementary Table 1 provides details regarding the treatments reported by patients by line of therapy, and Supplementary Table 2 presents the breakdown of current ALK TKIs as reported by patients.

Table 1. Patient baseline characteristics.

Variable	Overall (n = 104)
Age (years)	
Mean (SD)	53.64 (12.44)
Median	53.0
Min, max	22.0, 90.0
Age category, n (%)	
<31	4 (3.8%)
31–40	9 (8.6%)
41–50	31 (29.8%)
51–60	32 (30.8%)
61–70	19 (18.3%)
>71	9 (8.6%)
Ethnicity, n (%)	
Hispanic or Latino	5 (8.3%)
Not Hispanic or Latino	53 (88.3%)
Not reported	2 (3.3%)
Race, n (%)	
African American	1 (1.0%)
American Indian	1 (1.0%)
Asian	12 (12.0%)
Native Hawaiian	1 (1.0%)
Unknown	1 (1.0%)
White	84 (84.0%)
Sex, n (%)	
Female	70 (67.3%)
Male	34 (32.7%)
Geographic region, n (%)	
Armed forces America	1 (0.96%)
Midwest	23 (22.1%)
North East	19 (18.3%)
South	38 (36.5%)
West	23 (22.1%)
Employment status	
Employed	40 (40.0%)
Not Employed	60 (60.0%)
Disease stage at first diagnosis of NSCLC, n (%)	
Local	12 (14.8%)
Metastatic	53 (65.4%)
Regional	10 (12.4%)
Unknown	2 (2.5%)
Unsure	4 (4.9%)
Disease stage when confirmed with ALK+ NSCLC, n (%)	
Local	7 (6.7%)
Metastatic	77 (74.0%)
Regional	11 (10.6%)
Unknown	6 (5.8%)
Unsure	3 (2.9%)
Current line of therapy, n (%)	
First line	51 (49.0%)
Second line	32 (30.8%)
Third line	11 (10.6%)

NSCLC: Non-small-cell lung cancer; SD: Standard deviation; TKI: Tyrosine kinase inhibitor.

Table 1. Patient baseline characteristics (cont.).

Variable	Overall (n = 104)
>Third line	10 (9.6%)
Current treatment	
ALK TKI only	87 (83.7%)
ALK TKI and chemotherapy	2 (1.9%)
Chemotherapy only	2 (1.9%)
Other	13 (12.5%)
Includes [not mutually exclusive]:	
Radiation	10
Surgery	7
Clinical trial medication	7
No treatment	4
Immunotherapy	1
Unsure/other	6

NSCLC: Non-small-cell lung cancer; SD: Standard deviation; TKI: Tyrosine kinase inhibitor.

Among patients reporting current and prior treatment initiation dates (n = 93), most had received an ALK TKI as their first-line treatment (68.8%; n = 64), 63.4% (n = 59) had received an ALK TKI as their second-line treatment, and 28.0% (n = 26) received an ALK TKI as their third-line or higher line treatment where the response options were not mutually exclusive.

Patient preferences for treatment

Most patients felt that preventing disease progression (92%), treatment response (92%; i.e., shrinking tumor size), and improved HRQoL (88%) were very important attributes for their current treatment (Figure 2). The mean treatment preference scores (scale 1–5; where 1 = no influence to 5 = most influence) for the treatment attributes were: preventing disease progression 4.723, treatment response 4.657, and improved HRQoL 4.384. In considering a new treatment, a delay in disease progression of an additional 1, 3 and 5 months was perceived to be meaningful by 41.4, 57.7 and 68.3% of patients, respectively (data not shown).

Health-related quality of life (HRQoL)

MDASI-LC responses (n = 75) showed that the most bothersome patient-reported symptoms were fatigue, disturbed sleep, drowsiness, difficulty remembering things, and constipation. Mean MDASI symptom severity scores (on a scale from 0–10) were 3.57, 3.41, 3.04, 2.92 and 2.73, for fatigue, disturbed sleep, drowsiness, difficulty remembering things and constipation, respectively (Figure 3A). The proportions of patients assigning MDASI mean symptom severity scores of ≥ 5 were 38.7% for fatigue, 34.7% for disturbed sleep, 28.0% for drowsiness, 28.0% for difficulty remembering things and 25.3% for constipation (Figure 3B). More than half (57.3%) of the participants reported moderate to severe symptoms (defined as MDASI mean symptom severity score of ≥ 5 [26,27]) for at least one of the top five symptoms. Patients reported that symptoms caused interference with several activities of daily living captured by the MDASI-LC (i.e., walking, activity, work, relations with others, enjoyment and mood), with the greatest symptom interference for work and activity, both of which are components of activity interference.

MDASI total symptom severity and symptom interference were shown to be highly positively correlated, indicating that interference due to symptoms increased with severity. (Pearson correlation coefficient = 0.70983 with p-value <0.0001; Figure 4).

Healthcare resource utilization

Most patients used no medical services (i.e., physician office visits, outpatient clinic visits, hospitalizations, urgent care visits or ER visits; 31.7%; n = 32) or had used only one medical service during the 30 days prior to their survey date. Fewer than half of the patients (41.4%) had a physician office visit, 31.7% had an outpatient clinic visit, 7.7% had a hospitalization, 3.8% had an urgent care visit and 3.8% had an ER visit.

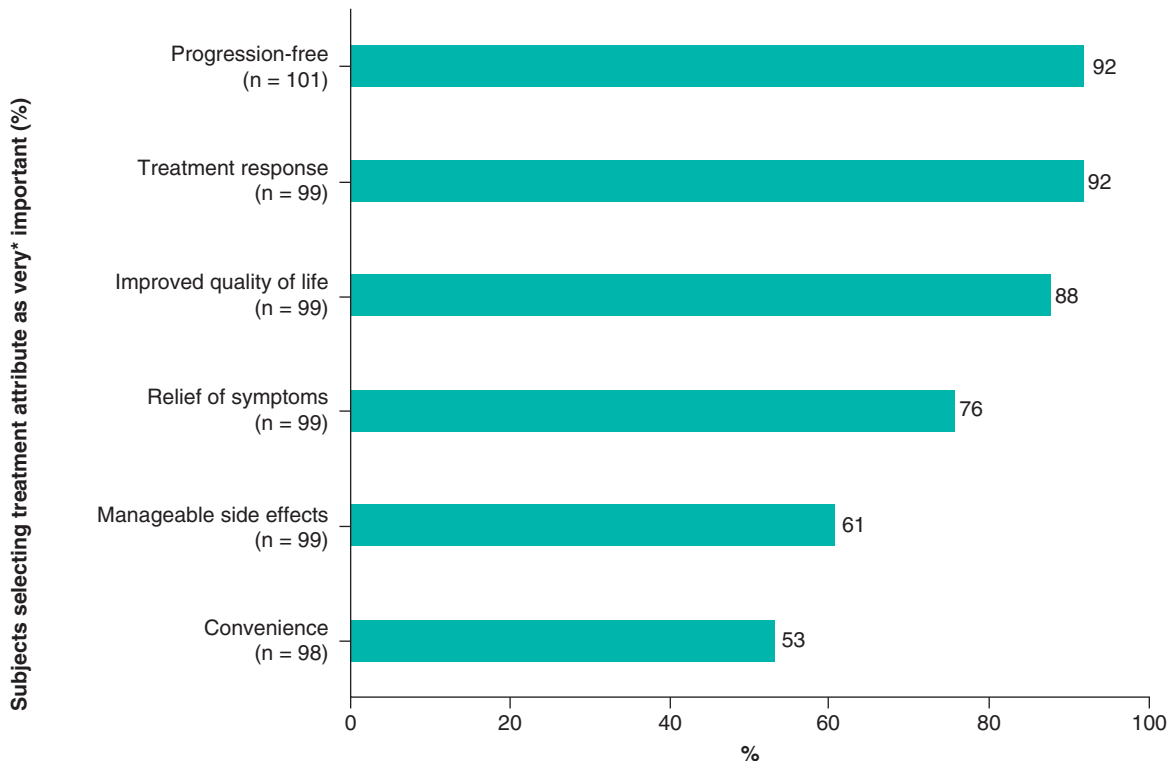


Figure 2. Treatment attributes very important to patients (n = 104).

*Very important was defined as having answered the question with 4 or 5, where 1 = no influence and 5 = most influence.

Associations between HRQoL & ALK TKI treatment & employment

MDASI-LC HRQoL scores were significantly greater for patients with current treatment with ALK TKIs (total symptom severity $p = 0.0062$, total interference $p = 0.0016$; Figure 5). HRQoL was maintained with 1 or 2 prior ALK TKIs (not taken concurrently), however HRQoL as measured by total symptom severity and interference was observed to decrease with 2 or more prior ALK TKIs (symptom severity $p = 0.1487$, interference $p = 0.0137$; Figure 6). Statistically significant associations were also observed between HRQoL and employment ($n = 27$; symptom severity $p = 0.0201$; interference $p = 0.0210$; Figure 7).

Discussion

People affected by cancer often have unmet emotional and social support needs [19], and evidence has shown that people with lung cancer benefit from active involvement in their healthcare decisions and from connection with other people [20,21]. The ALKConnect Patient Insight Network and Research Platform enabled people with ALK+ NSCLC to share their HRQoL, disease burden, preferences and treatment experiences and to learn about other people's experience of care from a web-based platform and with an assurance of privacy. People could learn how others manage a similar journey and could receive information on research studies and clinical trials. A study of patients with NSCLC found that patients who reported successfully connecting with other NSCLC patients (peers), support groups and/or community members reported a positive shift in feelings (52%) as they continued therapy or moved into a post-therapy phase (i.e., shift from feeling of shock and fear at diagnosis and/or fear and loneliness during the beginning of therapy to feeling more hopeful and confident when describing their current emotional experience) [21].

The real-world evidence gathered from the ALKConnect platform provides first-hand insights into ALK+ NSCLC patients' experiences of care and opportunities for addressing patients' unmet needs. Most patients enrolled reported that HRQoL (88%) and a delay in progression (92%) were very important treatment attributes for their current treatment as reflected in the mean treatment preference scores. These patient preference results are aligned with clinical trials that capture progression-free survival (PFS), objective response rates (ORR) and HRQoL. In

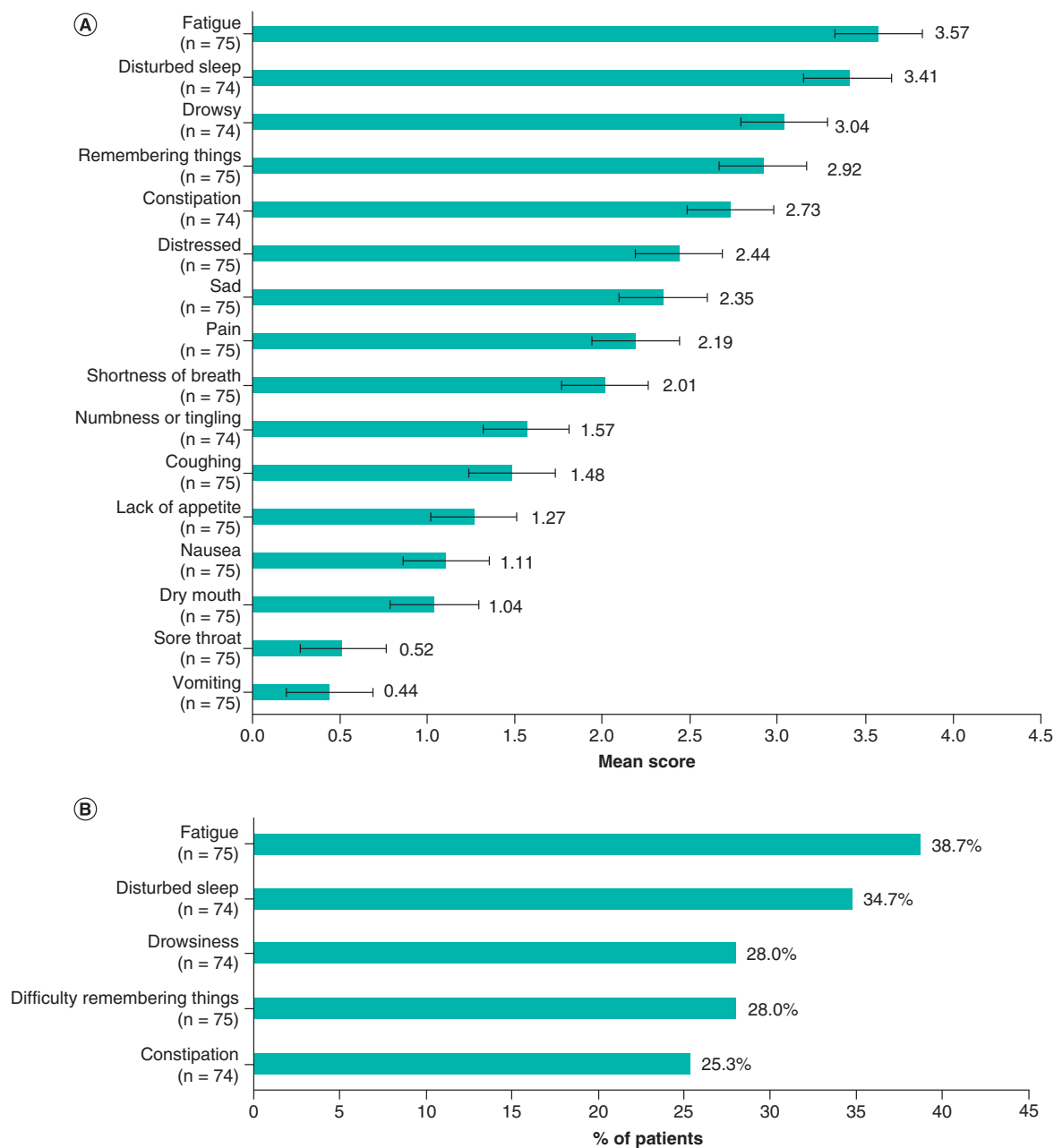


Figure 3. Patient-reported symptom burden (n = 75). (A) Mean MDASI Symptom Severity Score*; (B) most common moderate to severe symptoms (MDASI Mean Symptom Severity Score ≥ 5).

*For mean MDASI scores, 0 represents lower severity and 10 represents greater severity (i.e., higher scores indicate worse health-related quality of life).

addition to those clinical end points (PFS, ORR), which allow for assessment of the duration of tumor control and measurement of tumor shrinkage and tumor stabilization, HRQoL, a multi-dimensional concept, has become an integral end point in clinical trials for advanced cancer as it addresses the functional effect of a health status and/or a patient's treatment [28]. HRQoL-measured benefits have been shown to be consistent with the objective response benefits of ALK TKIs [29–33].

The patient preference findings are also relatively consistent with a qualitative study by Buzaglo and colleagues (2014) [21] which showed that patients with NSCLC reported that the most important dimension driving their decision of therapy was somatic (i.e., lack of physical pain and discomfort; 84%), followed by functional (having mobility and the ability to physically perform to personal and social expectations; 32%), relational (enjoyment

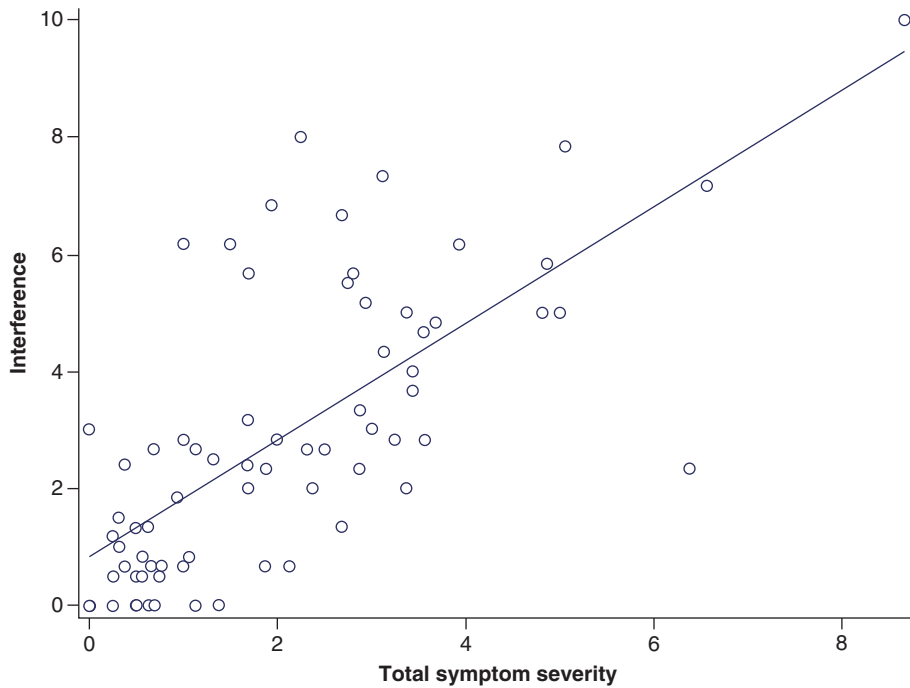


Figure 4. Correlation between total symptom severity and interference.
 Pearson correlation coefficient = 0.70983 with p-value <0.0001.

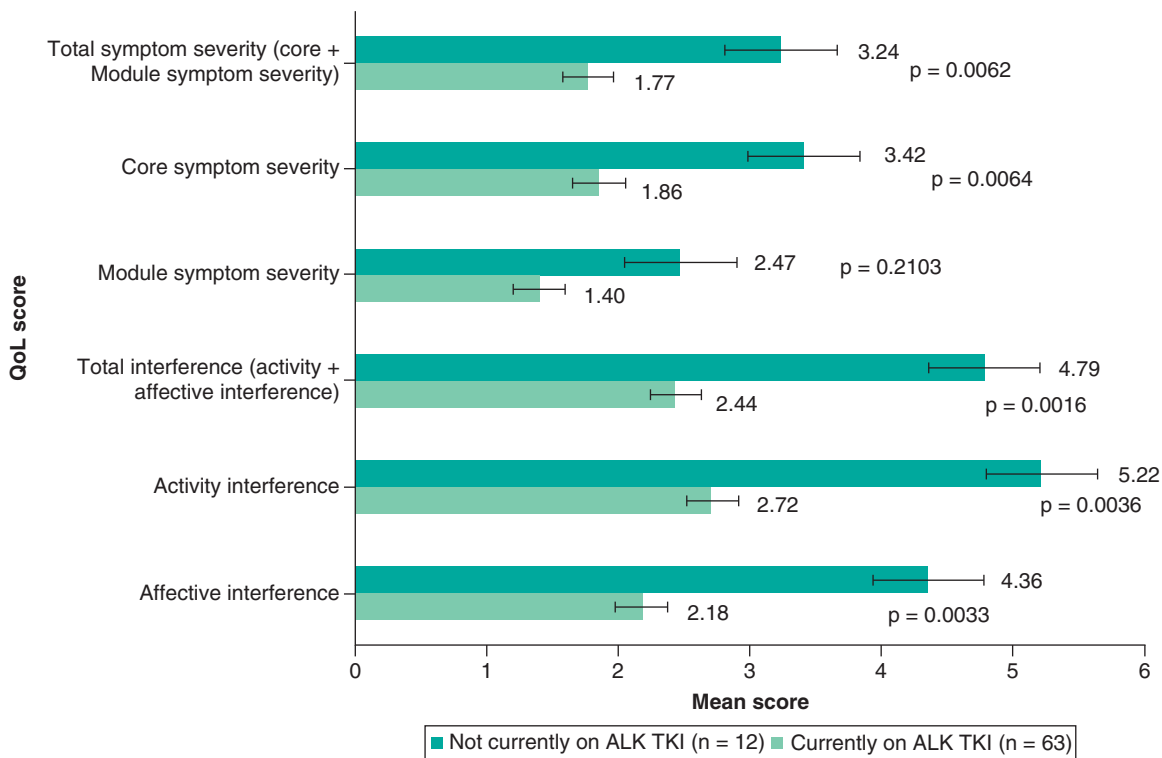


Figure 5. Symptom severity and interference with and without current TKI treatment (n = 75).
 For mean MDASI scores, 0 represents lower severity and 10 represents greater severity (i.e., higher scores indicate worse HRQoL).
 ALK: Anaplastic lymphoma kinase; HRQoL: Health-related quality of life; QoL: Quality of life; TKI: Tyrosine kinase inhibitor.

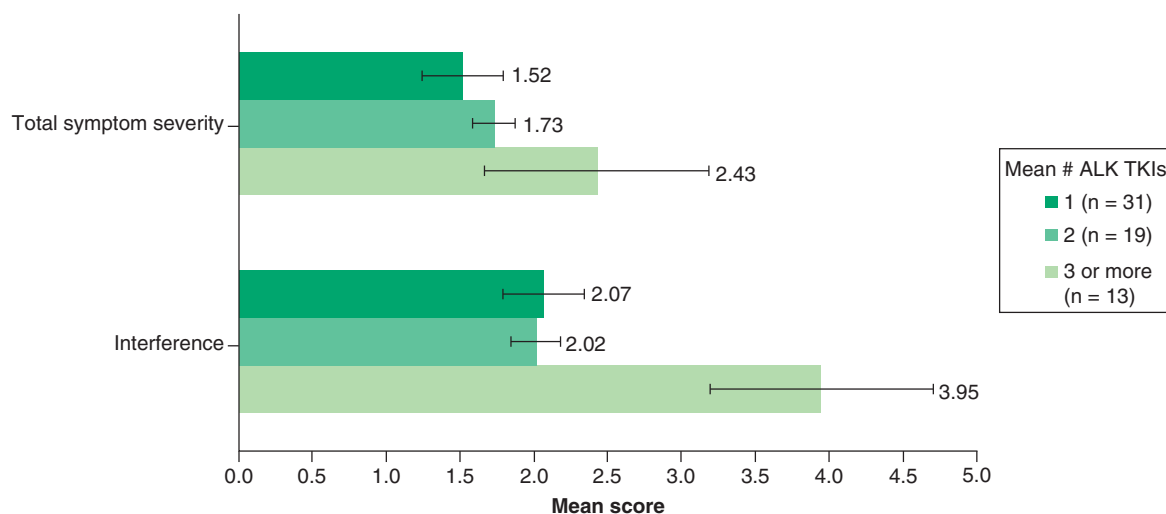


Figure 6. Symptom severity and interference by number of ALK TKIs (n = 63). For mean MDASI scores, 0 represents lower severity and 10 represents greater severity (i.e., higher scores indicate worse health-related quality of life). ALK: Anaplastic lymphoma kinase; TKI: Tyrosine kinase inhibitor.

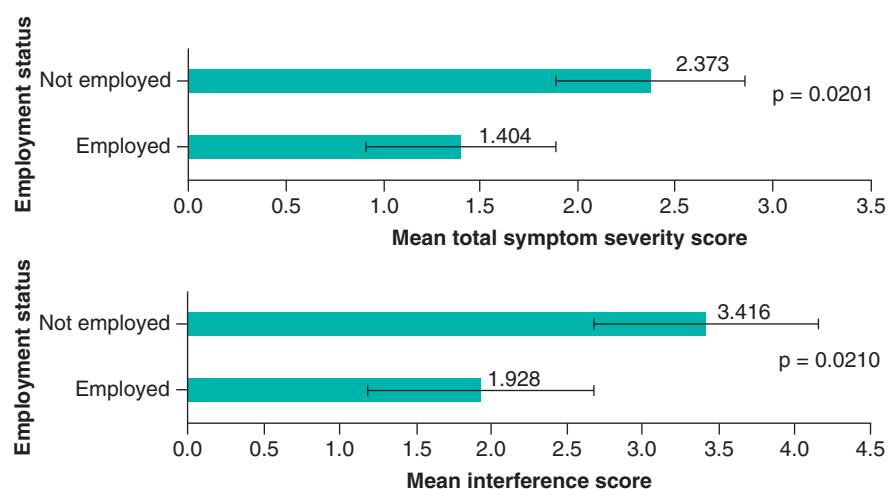


Figure 7. Employment status and health-related quality of life (n = 70).

and/or appropriate performance of social roles and interpersonal relationships, including at work; 23%), and emotional (emotional experience, such as happiness or sadness, deriving from satisfaction or dissatisfaction with lived experience; 10%) dimensions.

The top 5 most bothersome symptoms reported by patients in ALKConnect were fatigue, disturbed sleep, drowsiness, difficulty remembering things and constipation, with more than half of the patients (57.3%) reporting mean symptom severity that was moderate to severe for at least one of these symptoms. The prominence of these symptoms may be a function of the questionnaire used to ascertain them. The MD Anderson Symptom Inventory lung cancer module (MDASI-LC) includes 13 symptom items: pain, fatigue, nausea, disturbed sleep, distress, shortness of breath, difficulty remembering, lack of appetite, drowsiness, dry mouth, sadness, vomiting and numbness/tingling module [26]. Also, although ALKConnect was inclusive of patients across the disease spectrum, these symptoms may be indicative of a greater proportion of lung cancer patients who have already undergone treatment or whose cancer is under control. The findings are consistent with concerns of patients considering treatment of advanced nonsquamous NSCLC evaluated by McMullen and colleagues (2019) [34], and with findings for established lung cancer patients from the Cancer Experience Registry [35]. Fatigue has been shown

to be one of the overall key symptoms and burdens for lung cancer patients [34–37]. Poor sleep quality has been shown to be common in patients receiving treatment for NSCLC and is related to poorer quality of life and respiratory symptoms [38]. Interference caused by symptoms was largest for work and activity. Total symptom severity and symptom interference were highly positively correlated, showing that HRQoL interference was sensitive to changes in HRQoL symptoms in this population of patients, and that these symptoms impact activities of daily life.

People currently treated with ALK TKIs reported a better HRQoL than those not treated with ALK TKIs, suggesting the effectiveness of ALK TKI therapy especially for patients receiving a first- or second-line ALK TKI. TKIs have dramatically changed the outcome of ALK+ NSCLC patients and have paved the way for a new era of precision cancer medicine [39] with documented clinical benefit. The current study's findings are consistent with expert recommendations that therapy with ALK inhibitors be considered as a preferred approach in ALK+ NSCLC [40].

HRQoL was also associated with employment status, highlighting the significance of this aspect for ALK+ NSCLC patient well-being. This is consistent with a study by Wang and colleagues which showed that employment status was a factor in predicting the severity of unhealthy psychology in lung cancer patients [27]. Similarly, at the Mayo Clinic Epidemiology and Genetics of Lung Cancer Research Program, Morrison and colleagues found that current employment status was associated with emotional problems in a large sample of newly diagnosed patients with lung cancer [41]. Because studies have shown that cancer survivors are more likely to be unemployed than their healthy counterparts [36], and that employment status is linked to HRQoL, employment status should be taken into consideration when supporting patient well-being.

The ALKConnect Patient Insight Network and Research Platform collected disease burden information directly from the patient's perspective. The data collected may help improve shared decision making between patients and their healthcare providers. Healthcare professionals and researchers can gain first-hand insights into patients' experiences of care and unmet needs to support discussions and direction of treatment plans for patients. Improved coordination of healthcare provides an opportunity for achieving the goals of the triple aim of simultaneously improving the experience of care, improving the health of populations and reducing per capita costs of healthcare [42].

Limitations of this study include the fact that the findings were based on a small number of patients, were limited by the questions included in the survey, and were based on patient self-report. Patients were also subject to selection bias due to requiring online participation and presumably not fully representative of the broader population of patients. This was demonstrated in the finding that the proportion of patients who were female in this study was 67%, whereas it has been observed to be approximately half in other cohorts of ALK+ NSCLC patients [5,8]. Also, as described previously, the five most bothersome symptoms that were identified may indicate that a greater proportion of the patients had already undergone treatment or had cancer that was under control. The latest research from the Pew Research Center indicates that 81% of Americans had a smartphone in 2019 versus 35% in 2011 [43]. Therefore, online access has improved over time; however some patients may still be underrepresented such as those that are lower income or those who are less familiar with Internet surveys. These findings may also not reflect health care delivery and patient experiences of care in other countries.

The analyses were not intended to make comparisons across types of patients or across treatments but were rather intended to be used for descriptive purposes, such as characterizing the natural history of the disease and treatment experiences of this cohort. The findings reflect a snapshot of the patient and treatment characteristics at a specific period in time and may not reflect current treatment practices. The additional collection of data via ALKConnect from a greater number of patients could further validate these findings, and also further enable the evaluation of various patient subgroups with specific patient characteristics to determine what factors may be associated with the humanistic burden of ALK+ NSCLC. Additional planned future work includes the collection and analysis of longitudinal data in order to better understand the ALK+ NSCLC patient journey over time. Longitudinal analyses could provide deeper insights into the cause and effect relationships among variables and into the developmental trends over time.

Conclusion

The ALKConnect Patient Insight Network provided a platform to understand the humanistic burden directly from ALK+ NSCLC patients. ALKConnect demonstrated that disease progression, HRQoL, fatigue/sleep/drowsiness, ALK TKI+ treatment and employment may be significant factors for improving the quality of care of patients with ALK+ NSCLC. Online patient networks such as ALKConnect provide an innovative solution for gaining valuable

insights into experiences and outcomes that are meaningful to patients, providing a deeper understanding of the aspects of greatest significance to patients.

Summary points

- Social media communities are helping cancer patients and are considered a vital source for practical and emotional connection and support.
- Patients serve as mentors and as a support network by sharing similar experiences and relevant and experiential information which includes guidance and direction on disease education, medical experts, clinical trials, treatment options, side effect awareness and management, psychosocial support and hope.
- Given the rarity of diagnosis and low prevalence of anaplastic lymphoma kinase-positive (ALK+) non-small-cell lung cancer (NSCLC), not much is currently known about the patient experience; in particular the burden and impact of disease and patients' views of the most valued treatment outcomes are not fully understood.
- The objectives of this study were to analyze data collected thus far from the ALKConnect Patient Insight Network and Research Platform to evaluate real-world patient-reported preferences, experiences, and outcomes (e.g., health-related quality of life [HRQoL]), and to gain a greater understanding of perspectives on the unmet needs of patients living with ALK+ NSCLC.
- A 3-month delay in cancer progression and HRQoL were reported as important treatment attributes.
- Participants reported that the most burdensome symptom was fatigue, which may or may not include anxiety and depression, hope, sleep disturbance and drowsiness. Symptoms interfered most with ability to work and day-to-day activity according to participants.
- Patients' HRQoL was positively associated with ALK total kinase inhibitor (TKI) treatment and maintenance of employment status, suggesting that these aspects may be important for the overall well-being of patients with ALK+ NSCLC.

Supplementary data

To view the supplementary data that accompany this paper please visit the journal website at: www.futuremedicine.com/doi/suppl/10.2217/lmt-2020-0018

Financial & competing interests disclosure

HM Lin, H Huang and F Scipione are employees of Millennium Pharmaceuticals Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, and may own stock. At the time of the study X Pan, and A Biller were employees of Millennium Pharmaceuticals Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, and may own stock. R Sugarman is an employee of Xcenda LLC., which has received consultancy fees from Takeda Pharmaceutical Company. At the time of study, K Covey was an employee of Invitae Corporation which has received fees from Takeda Pharmaceutical Company Limited. H West discloses receiving advisor/consultant fees from AstraZeneca, Merck & Co., Eli Lilly and Company, Roche and Genentech and Takeda Pharmaceutical Company Limited, and speaker fees from Astra Zeneca, Merck & Co., and Takeda Pharmaceutical Company Limited. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

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Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

Informed consent disclosure

The authors state that they have obtained verbal and written informed consent from the patient/patients for the inclusion of their medical and treatment history within this paper.

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