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Quality of Life, Disability, and Fungal Neglected Tropical Diseases

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Abstract

Purpose of Review: This review summarizes current literature about the disability burden of the fungal neglected tropical diseases (NTDs) sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis. The review highlights current knowledge gaps in global settings and describes available tools that could be adopted to fill these gaps.

Recent Findings: Sporotrichosis, chromoblastomycosis, and eumycetoma often present initially as skin lesions that can become progressively disfiguring, lead to stigmatization, and cause various sequelae affecting health and function. Chronic paracoccidioidomycosis can have systemic involvement and commonly results in impaired pulmonary function, which can limit activities of daily living and employment capacity. Use of standardized tools to quantify disability with fungal NTDs has been limited to date. Standardized tools to measure the impacts on quality of life and mental health are available and have been used for similar patient populations, including persons with other fungal diseases and persons with non-fungal skin NTDs.

Summary: Fungal NTDs can be disabling. Improved understanding of the quality of life and mental health consequences might lead to greater awareness of the burden of fungal NTDs and enhance health planning to address the health and rehabilitation needs of persons affected by these diseases.

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Author Contributions

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Declarations

Ethics Approval This review article does not involve original research with human participants or animals.

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Keywords

Sporotrichosis; Chromoblastomycosis; Mycetoma; Paracoccidioidomycosis; Mental health; Stigma

Introduction

Neglected tropical diseases (NTD) are diseases that have historically received limited attention and tend to impact vulnerable populations affected by poverty. In 2021, the World Health Organization (WHO) published a roadmap to address NTDs, establishing global cross-cutting and disease-specific targets to be reached by 2030 [1]. Concerning fungal NTDs, the WHO roadmap includes sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis. Because fungi live ubiquitously in the environment, fungal NTDs pose unique challenges compared with their non-fungal counterparts. Elimination and eradication are not realistic goals for fungal NTDs, although protective clothing and equipment, as well as proper hygiene, particularly with any skin lacerations, may help to reduce risk of the fungal NTDs caused by implantation [2–4]. Timely diagnosis and appropriate treatment are important considerations to address for fungal NTDs. The limited available diagnostic options for fungal NTDs and the lack of access to antifungals in many regions create challenges that need to be tackled to reach 2030 targets.

Another major challenge is the limited scientific evidence regarding the burden of fungal NTDs. Data regarding the incidence and prevalence of fungal NTDs are limited and likely underestimated, largely due to diagnostic challenges. Morbidity data are scarcely reported. While most fungal NTDs are associated with low mortality risk, long-term disability is a major concern. However, a lack of published data regarding disability may result in an underappreciation of the true burden of these diseases. Consequently, resource allocation and public health planning may be insufficient to meet the health and rehabilitation needs of affected populations. For this report, we summarize published literature on fungal NTDs' impact on quality of life and disability, identifying gaps in current knowledge, and highlighting available tools that could be adopted to fill these knowledge gaps in global settings.

Measurement of Disability

The WHO's International Classification of Functioning, Disability, and Health (ICF) is a framework to describe health and disability, highlighting the interconnectedness of body structures and functions, activities, participation, environmental factors, and personal factors (Fig. 1) [5]. The ICF framework helps provide a common language to describe disability, but various methods for disability measurement exist. Quality of life (QOL) tools aim to measure "activities" and "participation" using the ICF framework, typically with self-reported questionnaires. QOL tools can be useful in quantifying how a person perceives they are doing in various aspects of their life, providing an overall measure of health and wellbeing.

Disability-adjusted life years (DALY) and quality-adjusted life years (QALY) are metrics that are frequently used to quantify and compare disability burden between diseases and regions. The limitations of such metrics are well-documented [6–8], yet DALY estimates are often used for resource allocation by comparing dollars spent per DALY saved. The disability weight used to calculate DALYs and QALYs depends on having baseline data that quantifies the severity of disability associated with the condition. In the absence of scientific data on specific conditions, disability weights are typically assigned by applying disability weights from similar conditions. A common criticism of DALYs with regard to NTDs is that disability weights do not incorporate the psychosocial and mental health consequences commonly associated with these diseases [6, 9, 10].

While standardized QOL tools or DALYs can quantify disability, the power of qualitative studies to explore the impact of diseases on quality of life should not be over-looked. Qualitative methods for investigating disability can help provide a deeper understanding of the lived experiences of people with fungal NTDs.

Current Knowledge about Disability and Fungal NTDs

A brief summary of disease epidemiology, clinical manifestations, and current knowledge regarding the burden of disability are presented for each of the four fungal NTDs.

Sporotrichosis

Sporotrichosis is caused by species of the *Sporothrix* genus, dimorphic fungi found throughout the globe in soil, plants, and decaying organic matter. Sapronotic inoculation, caused by thorns or other plant matter, is the primary transmission route for most species. However, in Brazil, where sporotrichosis caused by *Sporothrix brasiliensis* has reached hyperendemic levels, cat-to-human transmission is the most common transmission route; a growing, similar scenario is being reported in some neighboring countries [11–13]. Recently, reports of cat-to-human transmission among other *Sporothrix* species have also increased in Malaysia and Thailand [14–16]. Clinical presentation for sporotrichosis most commonly includes fixed or lymphocutaneous lesions. Atypical presentations involving joint, ocular (with external involvement becoming increasingly common), pulmonary, or central nervous system are less common, primarily occurring in persons with immunocompromised conditions. Sequelae can include joint ankylosis or destruction, at times requiring amputation, hydrocephalus, symblepharon, conjunctival fibrosis, and other conditions, depending on structures involved [17, 18]. Atypical presentations are reported more frequently with *S. brasiliensis* than with other species, including among immunocompetent patients [11, 19].

The cure rate for patients with an uncomplicated clinical presentation of fixed or lymphocutaneous lesions is high, and therefore a high burden of permanent disability for this population is not suspected. However, treatment is lengthy and may be complicated by hypersensitivity reactions, which can contribute to increased stress during treatment, potentially affecting mental health and quality of life. Stigma or discrimination may result from lesions that cannot be easily covered, including facial or hand lesions, which are

common injury areas for cat-transmitted sporotrichosis. Patients with sporotrichosis might be prevented from returning to work until their lesions have healed, due to employers' fears of contagion or concerns about public interaction with the unattractive appearance of lesions and scars. For those who work in healthcare facilities, having an open wound can pose a problem for safe return to work. Prognosis is poorer for those with atypical presentation (particularly with lung or brain involvement) [20], and disability among survivors is likely. Impairments are generally linked to the structures involved: joint pain, impaired range of motion, and difficulty walking (bone or joint involvement), dyspnea and fatigue (pulmonary), headaches, paresis, and other neurological signs (central nervous system), and eye pain/discomfort or blindness (ocular) are reported in the literature [21–23].

Chromoblastomycosis

Chromoblastomycosis is an implantation mycosis that can be caused by dematiaceous fungi from several genera, including *Fonsecaea* spp., *Cladophialophora* spp., *Phialophora* spp., and *Rhinocladiella* spp. Chromoblastomycosis is endemic in many tropical and subtropical areas, with the highest reported number of cases in Latin America, Africa, and Asia [24, 25]. Inoculation through plant matter is the most common route of transmission, and agricultural workers have an increased risk of developing chromoblastomycosis [24, 25].

Most cases start as wart-like skin lesions that initially are painless and non-pruritic. If left untreated, progression through the lymphatic system can occur and result in long-term complications, including lymphedema, tissue fibrosis, joint ankylosis, secondary bacterial infections, and, in rare cases, progression to squamous cell carcinoma [26, 27]. Time to diagnosis can range from several months to several years [24, 28, 29]. When long delays in diagnosis and treatment occur, the disease progresses in severity, resulting in disfiguring lesions that are difficult to cure.

Case studies and case reports account for a substantial proportion of published evidence on the clinical progression of chromoblastomycosis. In a review of publications from Latin America and the Caribbean, itching (50%), pain (34%), and functional limitations (16.9%) were commonly reported symptoms among patients with chromoblastomycosis [30]. These rates are likely an underestimation, as the omission of reporting of specific symptoms or impairments within a published case report may not equate with the absence of that symptom. Amputation, fibrotic tissue or ankylosis limiting mobility, difficulty walking, and inability to return to work have all been reported [24, 26, 31]. Notably, stigma and mental health have been minimally addressed in published case reports, although reviews have commented on the psychological impacts of this disease [29]. Mental health distress and stigmatization are common among those with other skin NTDs [32, 33] and are suspected to be similarly prevalent amongst those with chromoblastomycosis due to the disfiguring lesions and disease-related stress associated with prolonged treatment.

Eumycetoma

Eumycetoma can be caused by a variety of fungi, the most common of which is *Madurella mycetomatis*. Eumycetoma is considered an implantation mycosis, typically occurring after

the introduction of fungi from soil, plant, or other organic material through minor trauma, often from walking barefoot. Eumycetoma's causative agents are found world-wide, but eumycetoma is most prevalent in the "mycetoma belt," which includes the tropical and subtropical areas of Africa, Asia, and Latin America in the geographic area extending between 15° South and 30° North latitude [34].

Eumycetoma is most common in the feet and first appears as firm but painless masses under the skin. As lesions progress, sinuses with discharge develop. Long-standing lesions can invade bones, muscles, tendons, and nerves causing functional impairments and disfigurement. Similar to chromoblastomycosis, diagnostic delays for eumycetoma are common, with most patients presenting with advanced disease [35]. Surgical excision used for severe mycetoma, and amputations are reported in 38.5% of cases. Long-term infections lasting more than a decade and recurrence are common, occurring in 31.8%–46.6% of cases [36].

Compared with other fungal NTDs, disability in patients with eumycetoma has received more public health attention. A systematic review published in 2022 identified seven studies addressing disability in eumycetoma and reported that 60% of patients with mycetoma have moderate to severe restrictions in QOL [36]. A study from the Mycetoma Research Centre in Sudan, which evaluated the prevalence of disability among 300 patients presenting to the Centre, showed that 40% of patients reported difficulty walking, 25% and 40% experienced limitations in bathing and dressing, respectively, 44% of school-aged children reporting difficulty in attending school, and 24% reported difficulty in participating in religious activities [37]. Similar to chromoblastomycosis, agricultural work or farming occupation is a risk factor for developing disease [36], and many patients with eumycetoma are unable to return to work either due to the demanding physical requirements of the job or the need for frequent medical or surgical disease treatments. Published rates range from 9–40% of patients who report difficulty with employment due to the disease [36, 37].

Paracoccidioidomycosis

Paracoccidioidomycosis is a granulomatous systemic disease caused by thermally dimorphic fungi from species within the genus *Paracoccidioides*. Rural workers in Central and South America are the most commonly affected population [25]. Delays in diagnosis are common with paracoccidioidomycosis and can result in increased risk of both morbidity and mortality [38].

The disease manifests in three main clinical presentations: acute/subacute form, chronic form, and residual form [39]. In the acute form, hematogenous and lymphatic spread are observed with typical involvement of the liver, spleen, lymph nodes, and bone marrow. The chronic form is the most common form of paracoccidioidomycosis, with clinical manifestations predominantly in the lungs and mucous membranes of the respiratory and digestive tracts. Due to the fibrosing characteristics of this infection, patients often experience severe and lasting damage to affected organs, which manifests as a residual form. The most common sequelae include pulmonary fibrosis and emphysema, with the latter being particularly prevalent given that smoking is also strongly associated with the disease

[40]. Additionally, patients may suffer from irreversible vocal impairment in the larynx, Addison syndrome in the adrenals, and neurological sequelae that vary widely based on lesion location. Tracheal and gastrointestinal lesions can lead to obstructions necessitating surgical intervention. Skin involvement frequently results in disfigurement.

Permanent respiratory impairment occurs in up to 50% of patients with chronic paracoccidioidomycosis [38, 40]. In one study of 50 patients in Brazil, a spectrum of limitations was noted, including oxygen desaturation with activity, reduced walking distance with a 6-min walk test, and reduced QOL, as measured by the St. George Respiratory Questionnaire [40]. Paracoccidioidomycosis may result in economic challenges and the inability to return to work, as the disease causes breathing difficulties even with minimal exertion. Consequently, affected workers may lose their jobs and become economically dependent on family members [41]. Excessive alcohol intake is a risk factor for chronic paracoccidioidomycosis [42]. Anecdotally, a relationship between intensified consumption of alcohol after acquiring disease has been reported and attributed to mental health distress from economic dependency and the inability to return back to work. However, similar to the other fungal NTDs, the reporting of mental health and social consequences within the published literature is sparse.

Gaps in Knowledge

Few studies have specifically addressed disability among patients with fungal NTDs. Most published evidence comes from case reports or series, which have primarily focused on physical disability. Mental health impacts of fungal NTDs remain largely underexplored, despite the growing recognition that social stigmatization and feelings of depression and anxiety are highly prevalent among persons with other skin NTDs [32, 43, 44]. Large-scale epidemiologic studies that evaluate QOL using standardized tools would help quantify the burden of fungal NTDs. Without a complete understanding of the prevalence and types of disability, NTD programs and public health entities may fail to meet the health, rehabilitation, and assistive technology needs of persons with fungal NTDs [10].

Monitoring disability may serve as an indirect method of assessing progress towards timely diagnosis and treatment of fungal NTDs. Currently, diagnosis for fungal NTDs, particularly chromoblastomycosis, eumycetoma, and paracoccidioidomycosis, is often delayed months to years following infection, and by this time, significant disability has likely developed. As the global community advances towards more timely diagnosis and treatment, a reduction in the associated disability associated with these fungal NTDs is expected and is an important outcome to measure.

The lack of disability research for fungal NTDs may result in an underestimation of disability weights used in DALY estimates. DALY estimates can be useful to help advocate for appropriate economic funding to address diseases that cause significant disability burden. For example, a recent report by Rethink Priorities compared funding for fungal diseases to bacteria, viruses, and other pathogens and presented findings of low research funding/DALY ratio for fungal diseases [45]. However, the Rethink Priorities report mentions high uncertainty in the calculation of DALYs for fungal diseases due to limitations with published

scientific evidence on morbidity. The burden of fungal NTDs in terms of DALYs is not yet clear, largely due to limited data on disease incidence and duration, as well as limitations in understanding of disability among affected patients. Without evidence on disability burden, fungal NTDs may continue to be underfunded and underappreciated as a public health problem.

Tools and Approaches to Improving Disability Burden Measurements for Fungal NTDs

Standardized QOL tools have been underutilized in evaluating the disability burden of fungal NTDs. However, these tools have been successfully applied in studies among other populations, including persons with other fungal diseases or persons with other skin NTDs (non-fungal). A summary of commonly used QOL tools is presented in Table 1 and briefly summarized here.

Generic QOL tools that measure a patient's perception of their general well-being or health status have been used when investigating the impact of QOL in persons with fungal diseases (vulvovaginal candidiasis, chronic pulmonary aspergillosis, coccidioidomycosis) and non-fungal skin NTDs. The most commonly used generic QOL tools include the WHO Quality of Life Brief Version (WHOQOL-BREF) and the 36-item short-form survey (SF-36). The EuroQol 5 Dimension (EQ-5D), though a common generic QOL tool, has been used relatively infrequently among patients with non-fungal skin NTDs.

Condition-specific QOL tools are also available and may be more sensitive to capturing impairments based on the common clinical presentations of the patient populations. The Dermatology Life Quality Index (DLQI), a skin-specific QOL tool, has been used in several international settings for dermatophytosis [59–65] and non-fungal skin NTDs [10, 48, 49, 52, 68, 69]. The application of DLQI within a variety of low- and middle-income countries (LMICs) for similar skin and subcutaneous conditions suggests feasibility for use with the fungal skin NTDs: sporotrichosis, chromoblastomycosis, and eumycetoma. The Children's DLQI and Family DLQI are alternative versions that have been utilized less frequently for non-fungal skin NTDs, but may hold value in pediatric populations or to gather a familial perspective [52]. QOL measures specific for patients with respiratory limitations are available and may be useful for identifying QOL impacts for patients with paracoccidioidomycosis. The St. George's Respiratory Questionnaire has been used for one study among patients with chronic paracoccidioidomycosis in Brazil, [40] and may be an appropriate tool to more broadly apply to this population. Additionally, there are several tools to measure fatigue, another common complaint of patients with chronic paracoccidioidomycosis. The Fatigue Severity Scale has been used in the United States for coccidioidomycosis, [53, 54] and the Manchester COPD scale has been used in the United Kingdom for chronic pulmonary aspergillosis [59, 61]. However, neither of these have been broadly deployed in Latin America, where paracoccidioidomycosis is prevalent. A validated fatigue scale that is adapted to the cultural and environmental context, as well as language, of the setting may be more appropriate.

Several standardized mental health and stigma measurement tools have been used to investigate depressive symptoms, anxiety, and stigma among populations with non-fungal skin NTDs. The Self-Reporting Questionnaire (SRQ) and General Health Questionnaire (GHQ) for mental health disorder screening, Patient Health Questionnaire (PHQ-9) and Beck Depression Index (BDI) for depressive symptoms, and the Generalized Anxiety Disorder 7-item (GAD-7) for anxiety have been used in a variety of settings, including LMICs for non-fungal skin NTDs [10, 33, 44, 48, 50, 68, 75–77, 81–86, 88]. Tools to measure perceived stigmatization have been used less uniformly. The participation scale (P-scale), a questionnaire in which the individual rates their self-perceived ability to participate in a variety of societal activities as compared to peers, is perhaps the most widely utilized tool. It has been used in South America, Africa, and Asia with non-fungal NTDs [48, 91–94]. Other tools used in populations with non-fungal NTDs include the 5-Question Stigma Indicator and the Explanatory Model Interview Catalogue (EMIC) [33, 81, 91, 92, 96]. Stigma scales have not been used in a standardized fashion across diseases and regions. Different tools are often used depending on disease, region, and culture. Despite the non-standardized implementation of stigma tools, studies in patients with non-fungal skin NTDs report very similar psychosocial consequences between the diseases. Patients with non-fungal skin NTDs commonly express concerns over appearance, worries about being considered a burden to the family, perceived or experienced stigmatization due to fear of contagion, and the inability to fulfill traditional roles in their community [43]. Anecdotally, these concerns remain consistent with reported concerns from patients with fungal skin NTDs.

The validity and reliability of the aforementioned tools have yet to be assessed specifically for populations with fungal NTDs. Yet, the application of many of these tools in populations with similar clinical presentations and within similar environmental contexts suggests that these tools may be well-suited for measuring the disability associated with fungal NTDs. Recent publications have described efforts to create a cross-cutting NTD-disability toolbox that could standardize the measurement of disability across diseases [75, 97]. To date, persons with fungal NTDs have not been included in these studies to validate a cross-cutting NTD-disability toolbox, and future efforts to study populations inclusive of fungal NTDs would be beneficial.

Conclusion

Fungal NTDs are known to have disabling consequences, but the burden of disability associated with these diseases is rarely described in the scientific literature. Several QOL measures have successfully been used in global contexts to quantify the QOL impact of other fungal diseases and other non-fungal skin NTDs. Mental health and stigma are understudied issues among persons with fungal NTDs and could be considered along with measurements of QOL and disability. Disability and QOL impacts associated with fungal NTDs are critical for healthcare planning purposes, to ensure appropriate access to health (including mental health), rehabilitation, and assistive technology resources. In addition, better disability burden estimates of these neglected diseases may help to foster appropriate attention and funding from public health, governmental, and industry partners to address the long-term sequelae that result.

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Data Availability

No datasets were generated or analysed during the current study.

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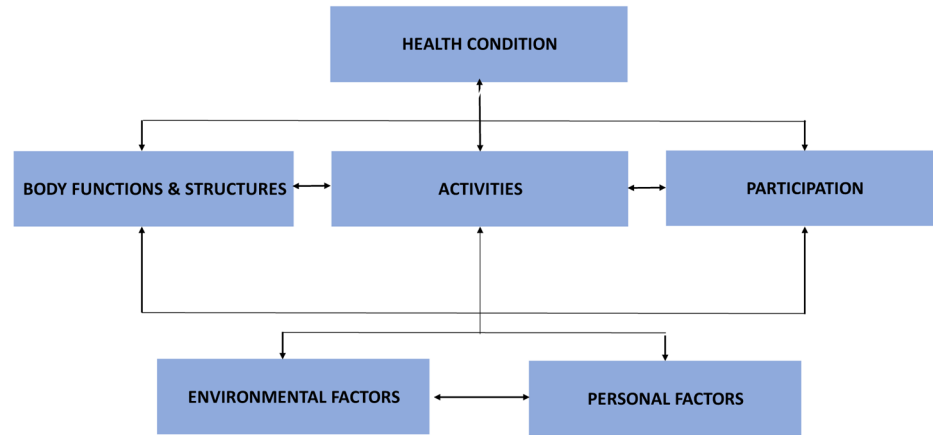
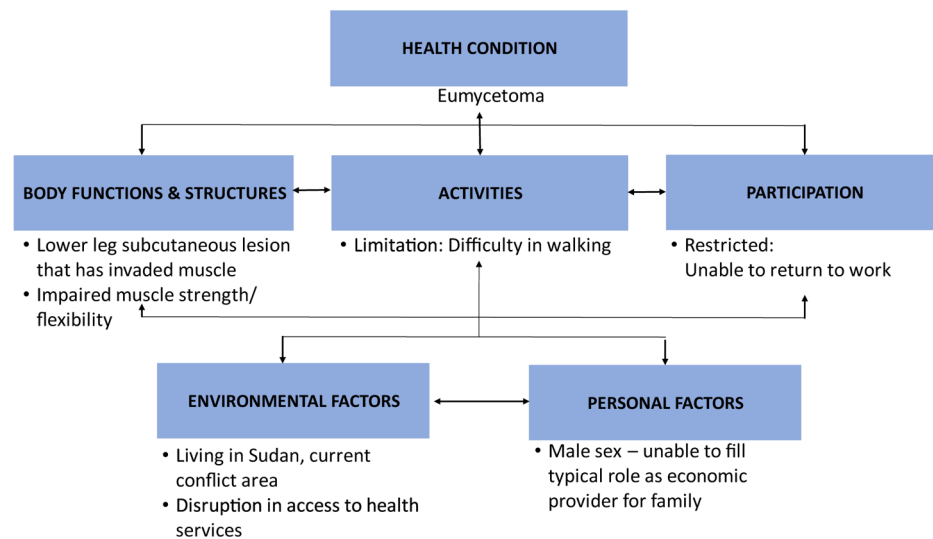
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A. International Classification of Functioning, Disability, and Health (ICF) Framework**B. ICF Framework applied to fungal Neglected Tropical Disease (NTD) example****Fig. 1.**

World Health Organization's International Classification of Functioning, Disability, and Health (ICF) with an example of application to fungal neglected tropical disease (NTD).

* adapted from WHO, 2001: <https://cdn.who.int/media/docs/default-source/classification/icf/icfbeginnersguide.pdf>

Summary of quality-of-life tools that may be applicable for use among persons with fungal neglected tropical diseases (NTDs)

Tool	Description	Applications with similar diseases	Considerations for fungal NTDs
Generic tool			
WHOQOL-BREF [46]	Generic 26-item tool that is intended to measure QOL in the context of a persons' culture and value systems. This is an abbreviated version of an original 100-item WHOQOL and includes four domains: 1. physical health 2. psychological health 3. social relationships 4. environment	<i>Fungal diseases</i> - recurrent vulvovaginal candidiasis in Brazil [47] <i>Other NTDs</i> - Leprosy in Bangladesh, Brazil, China, India, Malawi, Nigeria [48–50] - Buruli ulcer in Ghana [51] - Cutaneous leishmaniasis in Brazil, Tunisia [10, 52]	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
SF-36 (RAND-36) ^a	Generic 36-item health-related QOL with 8 scales 1. physical functioning 2. role limitations due to physical health 3. role limitations due to emotional problems 4. energy/fatigue 5. emotional well-being 6. social functioning 7. pain 8. general health	<i>Fungal diseases</i> - coccidioidomycosis in the U.S [53, 54] - chronic pulmonary aspergillosis in the United Kingdom and India [55–57] - recurrent vulvovaginal candidiasis in China, France, Germany, Italy, Spain, the United Kingdom, and the United States [47] <i>Other NTDs</i> - Leprosy in Bangladesh, Brazil, Ecuador, Ethiopia, India [48] - Buruli ulcer in Nigeria	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
Skin			
DLQI [58]	10-question survey that measures the impact of skin diseases on QOL	<i>Fungal diseases</i> - dermatophytosis in Australia, Bangladesh, India, Laos, Turkey [59–65] - onychomycosis in India, Thailand - Scabies in Turkey [66, 67] <i>Other NTDs</i> - Leprosy in Brazil, China, Ethiopia, India, Malaysia, Vietnam [48, 49, 68] - cutaneous leishmaniasis in Brazil, Egypt, India, Iran, Sri Lanka, Turkey [10, 52] - Lymphatic filariasis in Ethiopia, Haiti [68, 69]	May be most applicable for the skin NTDs: sporotrichosis, chromoblastomycosis, and eumycetoma
Respiratory			
St. George's Respiratory Questionnaire [70]	Questionnaire that measures three domains: 1. Symptoms 2. Activity 3. Impact Several versions are currently available. The original version includes 50 items, and the American version includes 76 items. COPD-specific and idiopathic pulmonary fibrosis-specific versions also exist	<i>Fungal diseases</i> - Chronic pulmonary aspergillosis in the United Kingdom and India [55–57, 71]	Used in a study for patients with paracoccidioidomycosis with chronic respiratory impairment [40]
Fatigue			
Fatigue Severity Scale [72]	9-item scale to measure impact of fatigue on functioning. It is most commonly applied to patients with multiple sclerosis and systemic lupus erythema	<i>Fungal diseases</i> - Coccidioidomycosis in the United States [53, 54]	May be applicable for paracoccidioidomycosis, but application in South America, where paracoccidioidomycosis is most prevalent, is limited. Other fatigue scales may be more appropriate, depending on the context of application
Manchester COPD fatigue scale	27-item COPD-specific scale of fatigue, measuring three domains of fatigue 1. physical 2. cognitive 3. psychosocial	<i>Fungal diseases</i> - Chronic pulmonary aspergillosis in the United Kingdom [71, 73]	May be applicable for paracoccidioidomycosis, but translated versions and applications outside of English-speaking countries to date are limited. Other fatigue scales may be more appropriate, depending on context of application

Tool	Description	Applications with similar diseases	Considerations for fungal NTDs
Mental Health			
Self-reporting questionnaire [74]	20-question yes/no questionnaire used to screen for mental health disorders, including depression, anxiety, and psychosomatic symptoms	<i>Other NTDs</i> - Leprosy in Bangladesh, Colombia, Ethiopia, India, Nepal [48, 75–77] - Leishmaniasis in Colombia [75] <i>Other NTDs</i> - Leprosy in Brazil, India, Japan, Nigeria [50]	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
General Health Questionnaire [78]	Self-assessment to screen for mental health disorders, including mood and anxiety disorders. Several versions are currently available, including the original 60-item scale and shorter versions (GHQ-30, GHQ-28, GHQ-12)	<i>Fungal disease</i> - Vulvovaginal candidiasis in the United States [80] <i>Other NTDs</i> - Leprosy in Brazil, Ethiopia, Nepal, Nigeria, [33, 44, 50, 68, 81–84] - Buruli ulcer in the Democratic Republic of the Congo [44] - Lymphatic filariasis in the Democratic Republic of the Congo, Ethiopia, Malawi, Nepal, Nigeria [33, 44, 68, 84–86] - Onchocerciasis in the Democratic Republic of the Congo [44]	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
PHQ-9 [79]	9-item questionnaire used to screen for depressive symptoms	<i>Other NTDs</i> - Leprosy in Brazil, India, Indonesia [50] - Cutaneous leishmaniasis in Iran, Saudi Arabia, Tunisia [10, 88] - Scabies in Turkey [66] <i>Fungal disease</i> - Vulvovaginal candidiasis in the United States [80] Other NTDs - Leprosy in Democratic Republic of the Congo, Nigeria [44, 83, 84] - Buruli ulcer in Democratic Republic of the Congo, Nigeria [44, 83] - Cutaneous leishmaniasis in Saudi Arabia [88] - Lymphatic filariasis in the Democratic Republic of the Congo, Nigeria [44, 84] - Onchocerciasis in the Democratic Republic of the Congo [44]	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
Beck Depression Inventory [87]	21-item self-report questionnaire to measure the severity of depression	<i>Other NTDs</i> - Leprosy in Brazil, India, Indonesia [50] - Cutaneous leishmaniasis in Iran, Saudi Arabia, Tunisia [10, 88] - Scabies in Turkey [66] <i>Fungal disease</i> - Vulvovaginal candidiasis in the United States [80] Other NTDs - Leprosy in Democratic Republic of the Congo, Nigeria [44, 83, 84] - Buruli ulcer in Democratic Republic of the Congo, Nigeria [44, 83] - Cutaneous leishmaniasis in Saudi Arabia [88] - Lymphatic filariasis in the Democratic Republic of the Congo, Nigeria [44, 84] - Onchocerciasis in the Democratic Republic of the Congo [44]	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
GAD-7 [89]	7-item self-report questionnaire to screen for and grade severity of anxiety symptoms	<i>Other NTDs</i> - Leprosy in Brazil, China, India, Indonesia, Mozambique, Nepal [48, 91–93] - Cutaneous leishmaniasis in Colombia [94]	May be applicable for all fungal NTDs: sporotrichosis, chromoblastomycosis, eumycetoma, and paracoccidioidomycosis
Stigma P-scale [90]	18-item scale quantifying self-perceived ability to participate in eight domains as compared to a peer: 1. learning and applying knowledge 2. communication 3. mobility 4. self-care 5. domestic life 6. interpersonal interactions and relationships 7. major life areas 8. community, social and civic life	<i>Other NTDs</i> - Leprosy in Brazil, China, India, Indonesia, Mozambique, Nepal [48, 91–93] - Cutaneous leishmaniasis in Colombia [94]	Likely applicable for fungal skin NTDs since it has been used with other skin NTDs in a variety of global settings May be applicable to paracoccidioidomycosis. However, it has not been reported in studies with populations with similar clinical presentations

WHOQOL-BREF, World Health Organization Quality of Life Brief Version; SF-36, 36-item short-form survey; P-scale, Participation-scale; DLQI, Dermatology Life Quality Index; PHQ-9, Patient Health Questionnaire; GAD-7, Generalized Anxiety Disorder 7-item; COPD, chronic obstructive pulmonary disease; QOL, quality of life; NTD, neglected tropical disease

^aThe RAND-36 contains the same questions as the SF-36 but uses a different scoring mechanism [95]

This table summarizes applications of some commonly used QOL tools, but it is not comprehensive in terms of all QOL tools available or used to date